

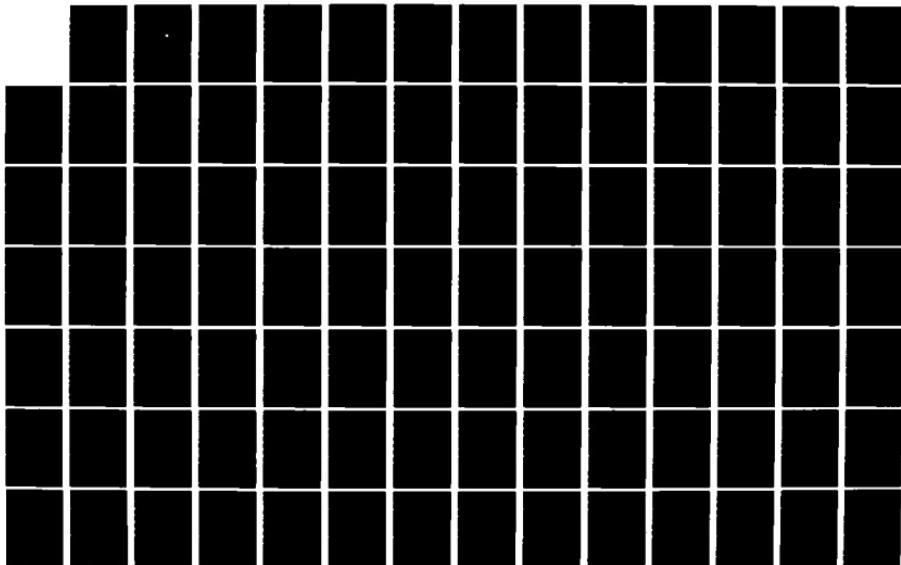
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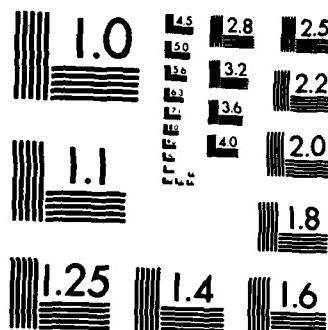
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THESIS

DEPRECIATION ACCOUNTING IN THE
UNIFORM CHART OF ACCOUNTS

by

Charles Lee George

December 1982

Thesis Advisor:

Shu S. Liao



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Comparisons are made between depreciation accounting in the military health service system and the civilian health care sector. Issues raised with the implementation of depreciation accounting within the Uniform Chart of Accounts are addressed and recommendations are made that may enhance the usefulness of the depreciation methodology.

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Depreciation Accounting in the
Uniform Chart of Accounts

by

Charles Lee George
Lieutenant, Medical Service Corps, United States Navy
B.S., College of Charleston, 1978

Submitted in partial fulfillment of the
requirements for the degree of

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ABSTRACT

This paper examines depreciation's contribution to the total cost of providing health care. In particular it analyzes the depreciation method used to measure the consumption of health care resources, the validity of the depreciation process and the subsequent allocation procedures. As defined by the Uniform Chart of Accounts, the usefulness of depreciation in determining the total cost of providing health care is attenuated by the fact that a major portion of a facility's capital assets are excluded from the depreciation process, the rate of depreciation understates the estimated useful service life of the assets, double counts certain expenses, and makes no provisions to periodically evaluate and adjust the composite rate of depreciation.

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I. INTRODUCTION

A. BACKGROUND

Outlays for health care in the nation reached approximately \$192.4 billion for the calendar year 1978 [Ref. 1]. This represented approximately 9.1% of the Gross National Product and amounted to approximately \$863 per capita expenditure [Ref. 1]. Since 1965 health care costs have grown at an average of 12.2% per year while prices in the economy as a whole have grown at a 9.0% annual rate. This imbalance has given rise to several attempts to control hospital costs either by fiat (Economic Stabilization Act) or through the enactment of federal laws such as the Health Maintenance Organization Act of 1973, P.L. 93-222 or the National Health Planning Act of 1974, P.L. 93-641. By the end of 1980 the cost of health care is estimated to be approximately 10% of the Gross National Product.

The Department of Defense has not escaped the effect that rising costs have had on the delivery of health care. Donald Rice [Ref. 2] has estimated that during the period of 1967 through 1978 health care costs were rising at a rate of 30% per year. The effect of these escalating health care costs became more acute as the post-Vietnam military budget was reduced in size and the purchasing power of the dollar was eroded by inflation and the significant increases in weapons system and personnel cost.

Anticipating the squeeze that would be placed on the military health care dollar the Department of Defense, Office of Management and Budget, and Department of Health, Education and Welfare, acting on a presidential mandate, initiated a joint study of the military health care system in 1973.

The study was concluded in 1975 and was generally complimentary toward the military health service system (MHSS). Not only did the study show that the MHSS provided a broad spectrum of medical services to more than nine million beneficiaries, but it demonstrated that the MHSS was capable of responding to a variety of military and civil emergencies. However, it did conclude that a number of opportunities existed to improve the effectiveness and efficiency of the MHSS while maintaining the delivery of quality health care to eligible beneficiaries [Ref. 3].

Of the nine major recommendations outlined, one poisted the need for a uniform medical data system within the three military services. This recommendation led to the development of a Department of Defense Uniform Chart of Accounts (UCA) [Ref. 4]. The UCA was designed to record, accumulate and report information regarding the expense and workload within military treatment facilities as a means of determining the total cost of treating a patient. Among the benefits that are expected to accrue to the MHSS by using the UCA are: (1) enhanced cost awareness, (2) cost effectiveness evaluation, (3) more effective decision-making when cost or

performance is a factor, and (4) better comparison among military medical facilities and with the civilian health sector [Ref. 4].

Appendix A contains an expanded explanation of the Uniform Chart of Accounts. The UCA is composed of six operating expense accounts, two intermediate and four final. It is the intermediate Support Service account that is of particular relevance to this thesis. It is within this account that the depreciation expense associated with military medical facilities capital assets are accumulated and eventually allocated to other support and mission centers.

B. PURPOSE OF THE THESIS

The purpose of this thesis is to analyze the issues confronting asset depreciation in the Naval Health Service System (NHSS).

1. Issues

a. Does the current UCA method recognize depreciation expenses in a systematic and rational manner?

b. Does the current UCA method of depreciation allow meaningful cost comparability among military medical treatment facilities and with the civilian health sector?

c. Is the UCA depreciation requirement so restrictive as to minimize the affect that depreciation has on the total cost of patient care?

d. Can depreciation's contribution to the total cost of patient care be isolated in order that management decisions will not be unduly influenced by a sunk cost?

C. RESEARCH METHODOLOGY

Thesis research methodology included a literature search to identify the types of depreciation commonly used in the health care industry, and interviews with civilian and military health care administrators to identify their views on depreciation accounting and each associated facility's used depreciation accounting. Military directives were reviewed to determine the basis for depreciation accounting. Statistical analysis of plant account records from selected Naval Regional Medical Centers was done to determine whether the assets shared common features such as service lives and similar populations.

D. THESIS ORGANIZATION

The remainder of the thesis will be arranged as follows:

Chapter Two will discuss two types of depreciation employed by business and industry in the private sector: Straight-line (to include unit and composite rates) and accelerated depreciation. Examples of each depreciation procedure will be given along with a synopsis of depreciation methods used by four civilian medical organizations.

Chapter Three will be a comparison and analysis of depreciation methods used by civilian hospitals and in the Uniform Chart of Accounts.

Chapter Four will be a critical analysis of UCA depreciation.

Chapter Five will contain recommendations for changes to the UCA depreciation methodology.

Chapter Six will summarize and conclude the thesis.

II. DEPRECIATION METHODOLOGY

The comparability of depreciation expenses among military medical treatment facilities and between military medical treatment facilities and the civilian health care sector can be greatly influenced by the method of depreciation chosen, depreciable base used and the estimated useful life of the assets involved. In order to adequately evaluate the issues surrounding depreciation and the subsequent use of the computed expense, an understanding of the effect different depreciation methods have on cost allocation would be helpful.

Therefore, this chapter will be concerned with describing the various methods of depreciation and the effect these methods have on the allocation of an asset's cost. It will cover factors affecting depreciation, as well as discuss the accelerated and straight-line method of depreciation. An illustration of the effect various depreciation methods have on cost allocation will be given, as well as briefly discussing the effect that changes in the general price level have on depreciation expense. It will also discuss the depreciation method used by the Civilian Health Sector.

A. FACTORS AFFECTING DEPRECIATION

Accounting for the consumption of long-lived assets under the accrual basis of accounting is done through a process of depreciation. Depreciation is an accounting procedure by

which the cost (less salvage value - if any) of fixed assets are allocated to expenses over the estimated useful lives of such assets in a systematic and rational manner; it is a process of cost allocation, not valuation. [Ref. 5]

The estimation of depreciation is dependent on three variables: Service life, depreciation base, and method of cost apportionment. The service life of an asset is the total units of service expected to be derived from that asset [Ref. 5]. Arriving at the total units of service involves choosing the appropriate unit in which service life is to be measured and then estimating how many units of service are embodied in each asset. This usually involves estimating the causes of the decreases in asset service and can generally be divided into two classes: physical causes and function/economic causes. Decreased asset service brought about by physical deterioration results largely from wear and deterioration over time. These physical forces terminate the usefulness of plant items by rendering them incapable of performing the service for which they were intended and thus set maximum limit on service life [Ref. 5]. Functional depreciation on the other hand arises from obsolescence or inadequacy of the asset to perform effectively. Obsolescence may arise when there is no further demand for the product that the depreciable asset produces, or the same function for substantially less cost. Inadequacy on the other hand refers to the effect that growth and changes in the scale of a facility's operations

have on the termination of the asset's service life [Ref. 6]. For example, an x-ray processor may be in sound condition, but if greater processing capacity is required which cannot economically be provided by modifying the current machine, the old machine has become inadequate and its economic service life to the hospital is ended. Generally, any asset is inadequate whose capacity is such that it cannot be operated with optimum results, or whose capacity does not or cannot fit the requirements of the organization [Ref. 6].

The second variable that must be considered is that portions of the depreciations base that should be charged against revenue during its service life. The depreciable base should include all normal expenditures of readying an asset for use and should consider the salvage value that may be realized at the end of the asset's useful life. Frequently, depreciable assets have little or no salvage value at the end of their estimated useful life and, if immaterial, the amount(s) may be ignored [Ref. 6].

B. METHODS OF DEPRECIATION

The goal of depreciation should be to provide a reasonable, consistent matching of revenue and expenses by systematically allocating the cost of the asset over its estimated useful life [Ref. 7]. The most commonly encountered methods in hospital accounting that attempt to accomplish this allocation are: straight-line depreciation methods (unit and group) and accelerated depreciation. These methods differ in that

depreciation under the unit straight-line and accelerated methods is a function of time, whereas depreciation under the group method is based on a weighted-average of the service lives of the assets involved [Ref. 7].

1. Straight-line Depreciation

a. Unit straight-line: The distinguishing characteristic of the unit straight-line method is that an equal portion of an individual asset's acquisition cost is allocated to each year of service life. The annual portion of the depreciation expense is computed in the following manner:

$$\text{Depreciation Expense} = \frac{\text{Acquisition Cost} - \text{Salvage Value}}{\text{Number of years in the service life}}$$

Another distinguishing feature of calculating depreciation expense for a unit depreciation schedule is that the decrease in assets useful life is constant over time. A principal advantage of the unit method is that it is simple to apply and it may result in a reasonably accurate measure of an asset's use. On the other hand, the objections to the straight-line method center around economic productivity and income measurement. Part of the controversy is that a constant depreciation charge for each operating period does not reflect variations in the rate of asset use and may accentuate fluctuations in net income. Another objection to this method is that for a given asset producing relatively constant earnings each period, the use of the straight-line method will show an increasing rate of return on the unrecovered

investment during each period of service life. Furthermore, a constant depreciation charge overstates an asset's economic productivity by not considering the fact that productivity declines sharply as the asset ages [Ref. 8].

b. Composite and group depreciation are forms of straight-line depreciation that are used when an organization finds it expedient to account for depreciation on a group basis rather than as individual assets. The term composite usually refers to a collection of dissimilar assets; while group depreciation refers to depreciating a collection of similar assets. In either case, they are processes of averaging the service life of a number of property units and then taking depreciation on the entire lot as if it were an operating unit. A distinguishing feature of a composite or group depreciation rate is that once the rate is computed, it is continued in use until there is a material change in either the composition of the assets or in the assets service lives [Ref. 9].

Basic assumptions underlying the use of a composite or group depreciation method are:

- (1) Assets are regularly retired near the end of their service lives.
- (2) Assets are replaced with similar assets.
- (3) Proceeds on retirement are approximately equal to the estimated salvage value [Ref. 9].

2. Accelerated Methods of Depreciation

The assumption that plant assets yield either a greater quantity of service or more valuable services in early years of service life has led accountants to devise methods of depreciation that will result in large amounts of depreciation being recognized in the early years of the asset's service life, and smaller amounts in later years (See Figure 1) [Ref. 9]. There are a number of different approaches that can be used to compute an accelerated depreciation rate. Only three will be dealt with in this thesis. These methods are: fixed percentage of declining balance, double-declining balance, and the sum-of-the-years-digits.

a. Fixed-percentage-of-declining balance method computes a percentage depreciation rate which when applied to the book value of the asset at the beginning of each period, will result in writing the asset down to its estimated net salvage value. The computed depreciation rate is applied on a consistently declining asset value. The amount of depreciation expense decreases each year. The formula for computing the required rate is:

$$\text{Depreciation Rate} = 1 - \sqrt[n]{\frac{\text{Net Salvage Value}}{\text{Acquisition Cost}}}$$

n = years of service life

A net salvage value greater than zero must be estimated.

Example: Asset acquisition cost is \$15,000

Net salvage value is \$1,500

Service life is 5 years

$$\begin{array}{r} 5 \quad \$1,500 \\ \hline \$15,000 \\ \text{Depreciation Rate} = 1 - \\ = 1 - .63 \\ = .37 \end{array}$$

b. Double-declining-balance method uses a rate that is twice the straight-line method [Ref. 9]. For example, an asset with a five year service life would have a double-declining rate of 40%, computed as follows: $2/n$ where n equals the asset's service life in years. The one limiting factor is that the asset can not be depreciated below its estimated net salvage value. Taking for example an asset with an acquisition cost of \$15,000, a salvage value of \$1,500 and a service life of 5 years, the double declining rate would be 40%. The depreciation expense in Year 4 would be \$1,269 and the book value of the asset would be \$1,944. Therefore, in Year 5 the maximum depreciation that could be taken would be \$544, reducing the asset's book value to the estimated net salvage value floor of \$1,500.

c. Sum-of-the-years-digits method computes a decreasing depreciation expense by a simple mathematical procedure relating to arithmetic progression [Ref. 6]. The sum of a

series of numbers representing the years of service life becomes the denominator of the depreciation fraction for any one year. The formula for determining the denominator of the depreciation fraction for an asset with a 5 year service life is: $n(n + 1)/2$, where n equals the service life in years - $5(5 + 1)/2 = 15$. The number of years of the asset's estimated service life is the numerator for the depreciation fraction in the first year. In each succeeding year the numerator is reduced by one, until in the last year the depreciation fraction becomes a reciprocal.

The depreciation expense for an asset with an estimated service life of 5 years in the first year would be $5/15$ of the depreciable base and in Year 5, $1/15$ of the base would be credited to the accumulated depreciation account. Since the denominator is constant and the numerator declines each year, the result is a decreasing depreciation charge. Because the total of the numerators of the depreciation fraction equals 1, 100% of the depreciable base will ultimately be charged to expense [Ref. 7].

3. Comparison of Different Methods

Figure 1 and Tables 1, 2 and 3 illustrate the effect that the foregoing depreciation methods have on the magnitude and timing of depreciation expense. Table 1 shows that by using the straight-line method, each year of service life absorbs an equal portion of the acquisition cost. The book value at the end of the fifth year equals the estimated salvage value.

Figure 1
Graphic Display
of the timing of
Depreciation Expenses
Shown in Figure 1

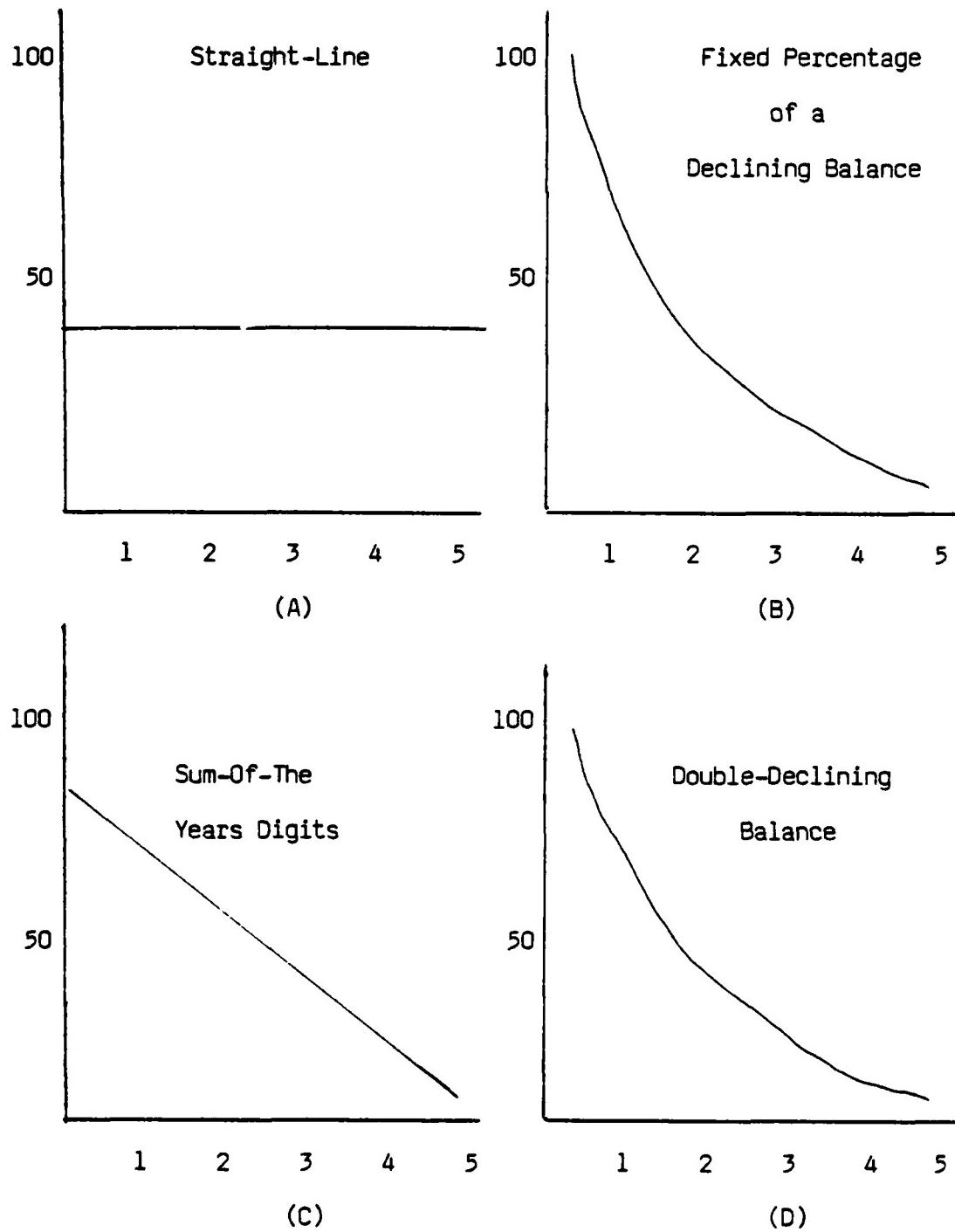


Table 1

Asset: Blood Chemistry Auto Analyzer

Acquisition Cost: \$200,000

Salvage Value: \$ 10,000

Service Life: 4 years

Service	Year	Straight	Sum of the Years	Double Declining	Fixed % of Declining
		Line	Digits	Balance	Balance
1	<u>Dpr Exp</u>	\$ 38,000	\$ 63,333	\$ 80,000	\$ 90,144
	<u>Book V1</u>	\$162,000	\$136,667	\$120,000	\$109,856
2	<u>Dpr Exp</u>	\$ 38,000	\$ 50,667	\$ 48,000	\$ 49,514
	<u>Book V1</u>	\$124,000	\$ 86,000	\$ 72,000	\$ 60,342
3	<u>Dpr Exp</u>	\$ 38,000	\$ 38,000	\$ 28,800	\$ 27,197
	<u>Book V1</u>	\$ 86,000	\$ 48,000	\$ 43,200	\$ 33,145
4	<u>Dpr Exp</u>	\$ 38,000	\$ 25,333	\$ 17,280	\$ 14,939
	<u>Book V1</u>	\$ 48,000	\$ 22,667	\$ 25,920	\$ 18,206
5	<u>Dpr Exp</u>	\$ 38,000	\$ 12,667	\$ 10,368	\$ 8,206
	<u>Book V1</u>	\$ 10,000	\$ 10,000	\$ 15,552	\$ 10,000

Table 2
Composite Depreciation Methods

Acquisition <u>Asset</u>	Service <u>Cost</u>	=	Depreciation <u>Life(Yrs)</u>	<u>Expense</u>
Surgical Instrument				
Cabinet	\$ 1,331		20	\$ 66
Electrosurgical				
Apparatus	\$ 13,032		8	\$ 1,629
Surgical Table				
(Remote Control)	\$ 8,910		15	\$ 594
Carniotomy Table	\$ 1,390		15	\$ 93
Telemetry Monitor	\$ 5,100		7	\$ 728
Physiological Sys				
Monitor (ICU)	\$ 85,000		7	\$ 12,143
Coloson - 53 Pediatric				
Stretcher	\$ 4,242		15	\$ 283
Double Pedestal				
Desk	\$ 1,003		20	\$ 50
<hr/>				
Total	<u>\$120,008</u>			<u>\$ 15,586</u>

Composite rate equals: \$15,586/\$120,008 = 12.9%

Table 3

Group Depreciation Methods

<u>Asset</u>	<u>Qty</u>	<u>Unit Cost</u>	<u>Total Cost</u>	<u>Serv Life</u>
Wheeled Hospital				
Stretcher	27	\$2,500	\$67,500	15

Under the group method this group of assets would contribute $\$67,500/15 = \$4,500$ annually as a unit to depreciation expense.

The composite depreciation rate is 12.9%, with a composite life of 6.8 years. Therefore 12.9% of the total acquisition cost of this dissimilar group of assets, or \$15,586, will be expensed each year so that in 6.8 years the accumulated depreciation amount will equal the composite book value amount.

The sum-of-the-years-digit method allocates a larger portion of the assets acquisition cost to the early years of service life. By the end of the fifth year the book value, like the book value obtained by the straight-line method, equals the estimated net salvage value.

Using the double-declining method (Table 1), a uniform rate is applied to the asset's current book value. Since book value is always reduced by the preceding year's depreciation expense, the rate is applied to a constantly declining book value. As previously mentioned, an asset can not be depreciated below its estimated salvage value when using the double-declining-balance method of depreciation.

Depreciation expense computed using the fixed-percentage-of-declining-balance method declines sharply after the first year and decreases at a decreasing rate until at Year Five the book value approximates the estimated net salvage value. The sharp decline in the depreciation expense occurs because the depreciation for each year after Year 1 is only 55% of the preceding year's expense.

C. GENERAL PRICE LEVEL EFFECT ON DEPRECIATION EXPENSES

In 1976 the American Hospital Association (AHA) recommended formally adjusting the plant asset accounts to reflect the effects of inflation as measured by changes in the general purchasing power of the dollar. As a means of adjusting the plant assets account, the AHA suggested using the index of

general prices known as the Gross National Product Implicit Price Deflator that is published quarterly by the Bureau of Labor Statistics [Ref. 8].

As an example of the procedure to adjust for inflation, assume that an asset purchased on 1 Jan 1980 at a cost of \$70,000 has estimated life of 5 years and a salvage value of \$10,000. The GNP Deflator on 1 January 1980 was 200 and on 31 December 1980 it was 212. The entries to record the price level change:

General Journal

Major Moveable Equipment

Price Level Increment \$4,500

Unrestricted Fund Balance

Price Level Reevaluation \$4,500

To record general price level increase.

$(\$75,000 \times 212/200) = \$79,500$

Historical Cost 75,000

Price Level Increase \$ 4,500

Depreciation Expense - Price

Level Adjustment

Accumulated Depreciation

Major Moveable Equipment

Price Level Adjustment \$ 720

To record price level adjustment on major moveable equipment depreciation.

(\$12,000 x 212/200) \$12,720

Historical Dpr Expense = 12,000

Price Level Increase \$ 720

Except for those companies that meet the requirements of the Financial Accounting Standards Board (FASB) Statement 33, entitled "Financial Reporting and Changing Prices," accounting for inflation has not gained the status of a generally accepted accounting principle [Ref. 6]. The AHA's recommendation is only a partial approach to the problem of accounting for the effects of inflation on hospital operations [Ref. 7]. However, its use, while not meeting all of the requirements for a generally accepted accounting principle is suggested as supplementary information to financial statements [Ref. 7].

III. DEPRECIATION METHODOLOGY USED BY CIVILIAN HOSPITALS AND THE MILITARY MEDICAL DEPARTMENTS

A. INTRODUCTION

Depreciation accounting is a recent occurrence within the military medical departments. It became an official part of the accounting and reporting systems in 1979 with the advent of the Uniform Chart of Accounts (UCA). The accumulation of depreciation expenses is an attempt to account for the cost of consumption of long-lived fixed assets as an operating expense over the property's estimated useful life.¹ It is a part of a larger expense collecting system that is designed to determine the total cost of patient care. The intent being among other things, to foster an atmosphere of cost awareness, enhance cost-effective decision making, make coherent work counts and serve as a gauge by which to make meaningful comparisons among military medical facilities and the civilian health sector [Ref. 4].

Depreciation can have a substantial effect on the determination of the total cost of patient care depending on such factors as the method of allocation selected, depreciable base used, and the useful life of the fixed asset. These factors can in turn influence the degree of comparability of

¹Fixed assets are defined as those long-lived property items not intended for resale in the regular business of the enterprise. Building and equipment constitute a subclass of the fixed assets category [Ref. 15].

the UCA cost figures among the military medical facilities and between the military and civilian health sectors.

In order to better understand the effect of depreciation on the cost of patient care and its subsequent effect on cost comparability, a description of the UCA depreciation methodology would be helpful. Accordingly, this chapter will be devoted to describing and analyzing the depreciation methodology used by civilian hospitals and the methodology used in the Uniform Chart of Accounts for Military Medical Treatment Facilities. Depreciation as a cost center within the Uniform Chart of Accounts will be described along with the threshold dollar value and type of equipment that contributes to depreciation expense. The basic assumptions underlying the UCA methodology will be analyzed and an example will be used to illustrate the procedures used to calculate the annual UCA depreciation expense.

B. DEPRECIATION METHODOLOGIES USED BY CIVILIAN HOSPITALS

The choice of depreciation used by a civilian hospital depends upon how the depreciation expense is to be used. Interviews with four civilian hospital finance directors revealed that depreciation was used to determine income, rate setting, Third Party reimbursements, cash flow generation, and for funding of asset replacements. Finance directors interviewed were from: Kaiser Foundation Health Plan, Inc., Oakland, CA., Community Hospital of the Monterey Peninsula, Monterey, CA., Grace Hospital Inc., Morgantown,

N.C., and California Hospital Association, Sacramento, CA.

Kaiser Foundation Health Plan is a prepaid group medical plan, the Community Hospital of the Monterey Peninsula and Grace Hospital Inc., are not-for-profit community hospitals while the California Hospital Association administers the MediCare and MediCal programs in the State of California.

Kaiser Foundation Health Plan uses either an accelerated

or straight-line depreciation method for any class of depreciable assets and either a composite or unit rate method for moveable equipment [Ref. 10, 11]. Depreciation is used for two purposes: (1) calculate reimbursement rates and (2) generate cash flow to meet future capital requirements.

Reimbursement rates receive a portion of the depreciation expenses based on guidelines set forth by the California Hospital Association and other Third-Party Payees [Ref. 10].

Funds provided by depreciation help meet future construction needs. According to Mr. Philip Beretta, Regional Controller for the Northern Region of the Kaiser Foundation Health Plan, Kaiser Foundation can borrow approximately 50% of the construction cost of a new facility. The other 50% must come from earnings [Ref. 10]. The amount of earning to be generated by prepaid dues is determined by estimating the total capital requirements for a ten year period, subtract funds provided by depreciation and borrowings during the same period to arrive at a dollar figure for prepaid dues.

The Director of Finance at the Community Hospital of the Monterey Peninsula [Ref. 12] uses straight-line depreciation in accordance with the accounting policies of the California Hospital Association. The resulting depreciation expense is used to compute a reimbursement rate.

Grace Hospital Inc., of Morgantown, N.C. [Ref. 13] uses straight-line depreciation for rate setting, third-party reimbursement and for funding for the replacement of capital assets. Grace Hospital Inc. sets aside funds in an amount equal to the annual depreciation expense to be used to provide for the replacement of capital assets.

The California Hospital Association stipulates that the method of depreciation used by hospitals for reporting to the Association's Health Facilities Commission must be straight-line depreciation method for all assets purchased after June 30, 1974 [Ref. 14]. If hospitals in California use a different method for accounting purposes, all timing differences created by the difference between accounting and reporting must be reflected in reports to the Health Facilities Commission. The corresponding depreciation figure(s) is/are used in determining reimbursement rates [Ref. 14].

Grace Hospital Inc. [Ref. 13] uses straight-line depreciation for rate setting, third-party reimbursement and for funding of capital assets replacement.

In selecting a method of depreciation, each hospital first decides the purpose for which depreciation will be used, then

the hospital selects the appropriate depreciation method. Straight-line depreciation was generally selected for rate setting and reimbursement. Accelerated depreciation was generally selected for cash flow and tax purposes.

C. DEPRECIATION EXPENSE UNDER THE UCA

Depreciation expenses under the UCA are computed using a form of depreciation similar to the composite rate methodology. Essentially the UCA method considers all equipment to have a useful service life of eight years and that all equipment subject to depreciation is fully depreciated after eight years [Ref. 4].

Basically, under the eight-year moving average the assignment procedure consists of adding the current fiscal years' purchases to the present totals. Then subtracting the oldest years totals as well as the dollar value of equipment surveyed, lost, or destroyed during the preceding year. The new total in each category (Dental Care, All Other) is divided by eight. The resulting figure is the current fiscal year's depreciation expense that will be allocated to the operating expense accounts on a quarterly basis [Ref. 4].

Table 4 is an example of the method used to determine the annual depreciation expense under the UCA procedures.

D. PROPERTY SUBJECT TO DEPRECIATION

Under the Uniform Chart of Accounts (UCA), depreciable properties will include only those cost associated with

Table 4

Value of Investment Equipment compromising the depreciable base - Fiscal Years 1972 through 1979:	\$1,584,000
Investment Equipment Purchased Fiscal Year 1980	<u>750,000</u>
	\$2,334,000
Less:	
Investment Equipment Transferred FY 1980	\$50,000
Investment Equipment Surveyed FY 1980	25,000
Modernization and or Replacement Investment Equipment Purchased FY 1972	(<u>475,000</u>)
Value of Investment Equipment comprising the depreciable base: FY1973 - 1980	<u>\$1,859,000</u>
Annual depreciation expense = \$1,859,000 x .125 depreciation factor (1/8)	
	\$ 232,375
Quarterly depreciation expense	58,094

modernization and replacement equipment. Any equipment less than the investment equipment threshold value of \$1,000 will not be depreciated.² Equipment less than \$1,000 will be charged to the receiving cost center as an operating expense³ [Ref. 4].

The only investment depreciation expense allocated to the operating expense accounts are those expenses associated with replacement and modernization equipment funded from the Other Procurement Appropriation [Ref. 4]. Specifically excluded from the depreciation process are expenses associated with: (1) new and expanded facilities, (2) those items classified as real property (elevators, environmental control units, etc.), (3) War Readiness Reserves, (4) support of any Program Element other than PEC 877110, "Care in Defense Facilities," and (5) support of Special Programs, such as vehicles, clinical investigations, drug abuse programs, and alcohol abuse rehabilitation.

² Investment equipment is equipment that is long-lived (greater than one-year), repairable and has a dollar value greater than \$1,000. After October 1980 the dollar value for Investment Equipment will increase to \$3000.

³ As defined by DODINST 6010.10M a cost center is a discrete functional or organization subdivision of a military medical facility for which provisions are made to accumulate and measure its expenses and determine its workload performance.

E. DEPRECIATION EXPENSE ALLOCATION

Distribution of the depreciation expenses between the Inpatient and Ambulatory care accounts is to be based on the average occupied bed days:

<u>Average Daily Occupied Bed Days</u>	<u>Distribution Inpatient</u>	<u>Percentage Ambulatory</u>
Greater than 250	60%	40%
Between 50 and 250	50%	50%
Less than 50	40%	60%
Clinics	-0-	100%

Once the distribution percentage between Inpatient and Ambulatory accounts has been determined, a ratio of occupied bed days for the inpatient account to the total number of occupied bed days will determine how much of the depreciation expense is to be allocated to the particular inpatient account. Allocation of the depreciation expense to the Ambulatory Care work centers is based on a ratio of ambulatory clinic visits to the total number of visits to the medical treatment facility [Ref. 4].

F. CONCLUSION

The depreciation methodologies used by civilian hospitals vary according to the use for which a hospital accumulates depreciation. Military hospitals choice of depreciation is set by fiat.

Civilian hospitals initially decide the purpose for accumulating depreciation and then selects the most appropriate

depreciation method. Straight-line depreciation is generally selected for rate setting and third-party reimbursements. While accelerated depreciation is usually chosen for cash flow purposes and tax avoidance.

The method used by military hospitals is established by the Department of Defense and is essentially a composite rate of depreciation with an useful life based on an eight-year moving average. The UCA depreciation method is used primarily in determining the full cost of patient care. Once computed, depreciation expenses are allocated to the various Inpatient Care and Ambulatory Care accounts based on the facility's daily average occupied bed days. After determining the distribution percentage between the two categories of accounts, distribution to individual accounts is done on a ratio of the individual account's work units to the total work units for the medical treatment facility.

IV. A CRITICAL ANALYSIS OF UCA DEPRECIATION METHODOLOGY AND RECOMMENDATIONS

A. INTRODUCTION

As stated in Chapter One, the Uniform Chart of Accounts was developed by the Department of Defense as a cost collection system designed to record, accumulate and report information regarding the expense and workload within a military treatment facility as a means of determining the total cost of treating a patient [Ref. 4]. An integral part of the total cost of providing health care is accounting for the consumption of long-lived fixed assets used in the delivery of health care. The accepted means of recognizing this consumption is through depreciation. Depreciation is defined as a system of accounting whose purpose is to distribute the cost or other basic value of tangible capital assets over the estimated useful life of the unit in a systematic and reasonable manner [Refs. 6, 21].

Accepting the foregoing definition, the UCA established a system of depreciation that would account for the consumption of long-lived assets and then allocate the consumption based on a ratio of occupied bed days, in the case of Inpatient Care, or a ratio of clinic visits for Ambulatory Care [Ref. 4].

Taking into consideration the UCA depreciation methodology and its underlying assumptions, four issues are raised:

- (1) Does the current UCA method recognize depreciation expense

in a systematic and reasonable manner? (2) Does the current UCA method of depreciation allow meaningful cost comparability among military medical treatment facilities and with the civilian health sector? (3) Is the UCA depreciation requirement so restrictive as to minimize the effect of depreciation on the total cost of patient care? (4) Can depreciation's contribution to the total cost of patient care be isolated so that management decisions will not be influenced by sunk costs? (5) Expense involving the purchase equipment in the \$1,000 to \$2,999 range are double counted.

The purpose of this chapter is to analyze the underlying assumptions regarding UCA depreciation and challenge the foregoing issues as well as offer recommendations that may enhance the value of depreciation accounting within the Uniform Chart of Accounts.

B. ASSUMPTIONS UNDERLYING THE UCA DEPRECIATION METHODOLOGY

The depreciation scheme used in the UCA is basically a composite rate of depreciation whereby the rate has been set by fiat at 12.5% [Ref. 4]. Assumptions that have to be made for the eight-year (or 12.5%) moving average to give valid depreciation information are: the useful life of the medical equipment is normally distributed throughout the population and has a mean life expectancy of eight years; retired assets are replaced with assets having similar useful lives; there will be no material change in the composition of assets; only

modernization and replacement equipment with a value above the \$1000 threshold contributes to the expense of providing medical care in a military medical treatment facility [Ref. 4].

As a means of testing the validity of the assumption that the average useful life of medical equipment is eight years and is normally distributed throughout the equipment population, a series of five random samples were drawn from equipment list of seven Naval Regional Medical Centers (NRMC) and analyzed to see if the eight-year mean useful service life was a reasonable figure. Statistical tests were completed to see if the individual samples were drawn at random, if they came from the same population, and if the sample averages came from identical populations. Appendix B outlines the methodology used to determine the mean, standard deviation, confidence interval, the results of the Runs Test for Randomness and the Kruskal-Wallis One-Way Analysis of Variance. The results of the analysis supports the contention that while the equipment in use at the various NRMCs come from identical populations, the eight year useful life is too low. The range of sample averages are:

	Confidence Interval at 95%	
	<u>Lower Limit</u>	<u>Upper Limit</u>
NRMC, Bethesda, Md	11.7 yrs	13.3 yrs
NRMC, Camp Lejuene, NC	11.5 yrs	13.5 yrs
NRMC, Charleston, SC	9.0 yrs	10.6 yrs
NRMC, San Diego, CA	10.6 yrs	12.4 yrs

NRMC, Camp Pendelton, CA	11.2 yrs	13.1 yrs
NRMC, Long Beach, CA	10.0 yrs	11.0 yrs
NRMC, Oakland, CA	11.0 yrs	12.6 yrs
Overall Confidence Interval	10.5 yrs	12.5 yrs

Intuitively, second and third assumptions are difficult to accept. Saying that retired assets are replaced with assets having similar useful lives and there will be no material change in the composition of assets one would have to ignore state-of-the-art changes in medical equipment. Plus, accept the contention that military medicine is a static undertaking that does not respond to innovation in health care.

The fourth assumption has the greatest impact on the amount of depreciation expenses that will be allocated to the inpatient and ambulatory care accounts. Considering only modernization and replacement equipment as contributors to the expense of providing medical care excludes a majority of a Naval Regional Medical Center's capital assets. In order to evaluate the impact of excluding real property and new and expanded facilities on depreciation expenses, real property and equipment records from four Naval Regional Medical Centers, Charleston, SC, Camp Lejeune, NC, Long Beach, CA, Bremerton, WA were reviewed and compared with the depreciation expenses reported under the UCA procedures for Fiscal Year 1980.

As can be seen from Table 5 the effect of excluding real property and new equipment can have a substantial impact on the amount of depreciation expenses that are allocated to the

Table 5
Depreciation of Investment Equipment
Real Property, New and Expanded
Facilities

<u>LOCATION</u>	<u>SOURCE OF INFORMATION</u>	<u>ACQUISITION COST</u>	<u>ESTIMATE 1 USEFUL LIFE</u>	<u>ANNUAL DEPR. EXPENSE</u>	<u>TOTAL DEPR. FOR YEAR</u>	<u>DEPRECIATION 2 REPORTED FOR UCA PURPOSES</u>	<u>VARIANCE</u>
<u>NRMC Camp Lejeune</u>							
Real Property ³ Equipment <u>NRMC, Charleston</u>	Ref. 16 Ref. 16	\$10,751,000 6,926,703	40 years 12.5 years	\$268,775 554,136	\$882,911	\$263,968	(\$558,943)
Real Property Equipment <u>NRMC, Long Beach</u>	Ref. 15 Ref. 15	\$16,492,062 3,564,003	40 years 10 years	\$412,301 356,400	\$768,701	\$454,000	(\$307,701)
<u>NRMC, Bremerton⁴</u>							
Real Property Equipment (\$2,634,708)	Ref. 18 Ref. 19 Ref. 20	\$23,571,768 5,318,339	40 years 10.5 years	\$589,294 506,508	\$1,095,802	\$ 41,400	(\$1,054,402)

1 Appendix B, Figure 13

2 Data taken from the Medical Expense Performance report for each activity.

3 Real property includes building, sidewalks, parking lots, elevators, etc. In the interest of brevity all real property was depreciated at 40 years. The difference between individual useful service lives and the composite figure of 40 years used in this example was immaterial.

4 New facility has been constructed at Bremerton. Equipment total includes all equipment with a dollar value in excess of \$1,000.

various medical care accounts. Several strong assumptions were made regarding the depreciable base: no equipment in service exceeds the composite service life in Column Five; all of the property and equipment are used in support of Program Element "Care in Defense Facilities," PEC 877110.

The effect that the foregoing assumptions have on the overall amount of depreciation expense of course varies within each facility. However, the value of the comparison is not to show an absolute dollar variance. Rather it is to show the magnitude of the variance. Excluding real property and new or expanded facilities from depreciation results in a variance in reported depreciation that ranges from \$307,000 for NRMC Charleston, SC to around \$2,700,000 for the new facility at Bremerton, Washington. In Table 5, Real Property was depreciated using a 40 year useful service life. The category Real Property includes not only buildings with 40 year estimated useful lives, but sidewalks, parking lots, elevators and other items with estimated useful lives that range from 12 to 25 years. However, in the final analysis the difference in depreciation expense using a composite life of 40 years and depreciating each item at its estimated service lives was immaterial.

C. UNIFORM CHART OF ACCOUNT'S DEPRECIATION: IS IT SYSTEMATIC AND REASONABLE?

According to L. Van Seawell [Ref. 21] depreciation of plant assets should be recognized by hospitals. The periodic

charge should be based upon a systematic and reasonable allocation of the previously recorded acquisition costs of such assets. Accepting this premise at face value gives rise to a two part question about the current UCA depreciation method. Is the UCA recognition of depreciation systematic and reasonable?

Under the UCA depreciation is computed in a systematic manner. Guidelines are established to determine service life of the assets to be depreciated, the depreciable base is defined, and the method of allocating depreciation to the operating expense accounts is outlined.

The reasonableness of the Uniform Chart of Accounts' depreciation can be questioned on several points: (1) excluding certain assets from depreciation understates the cost of providing patient care, (2) the eight year service life understates the useful service life of the assets that are depreciated, and (3) allocating depreciation from a common cost pool disregards the fact that some clinical services are more equipment intensive than others.

Under the Uniform Chart of Accounts, only modernization and replacement equipment with a dollar value equal to or greater than \$1,000 will be depreciated [Ref. 4]. Excluded from this category of equipment are all buildings, land improvements, furniture, new equipment and equipment with an acquisition cost of under \$1,000. Referring to Table 5, one can gauge the effect that excluding real property, furniture

and new equipment from the depreciation process has on the annual depreciation expense. In the case of a new facility like the Naval Regional Medical Center, Bremerton, WA, the foregoing exclusions can result in understating the annual depreciation expense by about \$2,600,000. The same exclusions will understate depreciation expenses for an established facility like Naval Regional Medical Center, Charleston, SC by approximately \$300,000.

Any process that ignores expenses ranging from \$300,000 to \$2,600,000 because of the source of funding [Ref. 4] used to acquire the assets, or because of the assets classification, appears to be unreasonable. If the purpose of accounting for depreciation within the UCA is to get a better picture of the cost of providing medical care, the process should not overlook assets that form the bulk of the cost of the medical facility. Irrespective of how the assets were acquired or what class of asset is involved, all assets are a cost to the government and they are expenses attributable to providing medical care. As such, they should be considered in accounting for the cost of providing medical care.

Another aspect of UCA depreciation that is open to question is the validity of the standard eight year service life. As indicated by Appendix B there is sufficient variation between estimated service lives from the seven NRCM's sampled as to suggest that a uniform depreciation rate does not accurately represent how long individual Medical Centers can expect to

utilize their investment equipment. The eight year figure understates the average estimated service life by a percentage that ranges from 13% to 35% for the Naval Regional Medical Center Charleston, SC and from 46% to 69% for the Naval Regional Medical Center, Camp Lejeune, NC. Considering the range of the variation between the standard depreciation rate and the various rates indicated by Appendix B, the accuracy of determining the composite service life for each facility could be improved if each facility computed individual composite rates of depreciation.

However, data processing equipment obviates the need to compute a composite rate of depreciation. NRMCS currently possess sufficient data processing equipment to be able to depreciate individual pieces of equipment on a straight-line basis and circumvent the tedious manual task of trying to accurately figure straight-line depreciation for a large number of dissimilar assets. The necessary information is maintained by each NRMC. Plant property records list the item, acquisition cost, date the asset was placed in service, and estimated service life, and the department to which the asset is assigned [Ref. 22]. Using these data and with the help of a computer, it becomes a minor task to write a program or a subroutine to an existing program, that will compute and total the depreciation expense. The convenience of using a computer to figure depreciation expenses obviates the need for simplicity in a manual system and bypasses the assumption

that retired assets are replaced with assets having similar costs and useful lives, events that rarely, if ever, occur.

The reasonableness of the depreciation allocation process can be challenged on the grounds that it inequitably assigns expenses to the various cost centers. All depreciation expenses are assigned to a cost pool, then allocated on the basis of a ratio of clinic visits in the case of ambulatory care, or a ratio of occupied bed days for inpatient care. Allocating depreciation on the basis of such ratios does not take into account that certain clinical services are more capital intensive than others [Refs. 19, 20]. For example, a Coronary Care Unit (CCU) will have more money invested in equipment than will a more labor-intensive inpatient service such as a Neurology Service [Refs. 15,16]. Under the UCA procedures all inpatient accounts receive a proportional share of equipment depreciation expenses irrespective of the amount of equipment that the account owns. In effect, the heavy investment of any service in equipment is distributed to other services. Consequently, the cost of operating an equipment-intensive service is understated while the cost of operating the labor-intensive service is overstated. The same effect is seen in allocating depreciation to the Ambulatory Services. Those Ambulatory Services, such as a Primary Care Clinic, that are labor-intensive receive a disproportionate share of the depreciation expense.

It would be more equitable and no more difficult to charge depreciation expense on equipment to the using cost center. Then only in those cases where a piece of equipment is not readily identified to a particular cost center should the corresponding depreciation expense be accumulated in a common cost center and allocated to all cost centers on the basis of occupied bed days or number of clinic visits [Refs. 24, 25].

A companion to the reasonableness issue is one that deals with the double counting of certain UCA expenses. In particular the double counting of expenses associated with the purchase of equipment in the \$1,000 to \$2,999 range. In the absence of either increasing the UCA depreciation threshold value to \$3,000 or making year-end adjusting entries, double counting of expenses associated with the purchase of equipment whose acquisition cost ranges from \$1,000 to \$2,999 will be a problem that will appear during Fiscal Year 1981 and beyond.

Double counting expenses will occur because of the variance in the way investment equipment is defined by the Resource Management System and the Uniform Chart of Accounts. In Fiscal Year (FY) 1981 the Resource Management System increased the threshold value for Investment Equipment from \$1,000 to \$3,000 [Ref. 26]. However, the Uniform Chart of Accounts still maintains the threshold value for Investment Equipment at \$1,000 [Ref. 4]. Without adjusting the UCA threshold value it will

be possible to expense the cost of a piece of equipment in the year of acquisition and then turn around and depreciate it over an eight year period beginning in the following fiscal year.

Under the Resource Management System (RMS) equipment costing less than \$3,000 will be purchased with Operations and Maintenance (O&M) funds [Ref. 26]. The purchase of equipment with O&M funds is subsequently reported on the Functional Category/Expense Element Report, NAVCOMP 2171, as an expense [Ref. 26]. The Uniform Chart of Accounts in turn allocates the expense reported on the NAVCOMP 2171 to the appropriate UCA operating expense account. However, since the equipment depreciation threshold value under the UCA is still \$1,000 [Ref. 4], there is a potential for either overstating depreciation expenses by 12.5% for eight years, or overstating operating expenses for the cost center by an amount equal to the total cost of equipment purchased in the \$1,000 to \$2,999 range in the year of acquisition.

D. DOES THE CURRENT UCA METHOD OF DEPRECIATION ALLOW MEANINGFUL COST COMPARABILITY AMONG MILITARY MEDICAL TREATMENT FACILITIES AND WITH THE CIVILIAN HEALTH SECTOR?

Comparability among military medical treatment facilities is assured by the fact that all of the military facilities are governed by the same Department of Defense directives and are required to account for depreciation in the same way, following identical allocation procedures [Ref. 4].

Comparability between military medical treatment facilities and civilian health care centers is another matter. Where the uniformity within the Department of Defense assures that all military medical treatment facilities follow the same guidelines in computing and allocating depreciation the lack of uniformity between the military and civilian health sectors in the use of depreciation accounting impedes cost comparability between these two sectors. Table 6 illustrates the dissimilarities between the UCA depreciation methodology and the methods commonly used in the civilian health care sector.

The driving force behind a civilian medical facility's choice of a depreciation method is the purpose to which the resulting expense will be used. For example, if the purpose of depreciation is to generate cash flow, accelerated depreciation would be used [Ref. 10]. However, if the purpose for accumulating depreciation is to determine a contractual reimbursement rate, straight-line depreciation would be used [Ref. 28].

Table 6 illustrates that there is no uniformity in the types of depreciation used by the civilian health care sector, with the choice of depreciation relying on the purpose to which the calculated expenses will be used. Lacking uniformity, cost comparison between military and civilian medical facilities is meaningless when the final cost figures include depreciation expenses. Depending on the method used, the estimated useful life, class of asset depreciated, and the

Table 6

Dissimilarites between the
Uniform Chart of Accounts
Method of Depreciation and
Depreciation Methods used in
the Civilian Health Sector

<u>Item</u>	<u>Uniform Chart of Accounts</u> ¹	<u>Civilian Health Sector</u> ²
Threshold Value for Asset Capitalization	\$1,000	Variable. Ranges from \$25 to \$25,000 depending on the class of asset being capitalized.
Class of Asset Depreciated	Modernization and replacement equipment only. Real property new and expanded facilities are not depreciated.	Generally any asset that exceeds the capitalization threshold value and has an expected useful life greater than one year.
Depreciation Method	Modified Composite Rate. Composite rate of depreciation has been established by fiat at 12.5% (eight year useful life).	Generally straight-line depreciation is used for reimbursement rate setting and accelerated depreciation is used for accounting purposes.
Method of Allocation	Based on a ratio occupied of bed days or a ratio of clinic visits. Does not charge depreciation directly to the using cost center.	Assigns direct cost depreciation to specific cost centers. Allocates indirect cost based on the value of equipment or the square footage of building occupied.
Reason(s) for accounting for depreciation	Compute full cost of patient care	Rate setting, cash flow generation and funding for depreciation ³

1 Reference 4.

2 References 10, 12, 13, 14, 28.

3 Funding of depreciation refers to the process by which cash resources are set aside periodically and accumulated for the purpose of financing the renewal or replacement of plant assets. (Ref. 21)

	NAVAL REGIONAL MEDICAL CENTER			
	Camp Lejuene	Charleston	Long Beach	Bremerton
<u>INPATIENT CARE</u>				
Total Occupied Bed Days ¹	45,937	50,697	36,642	23,678
Fourth Quarter FY80 Cost Year-To-Date	\$8,035,100	\$9,924,728	\$9,955,199	\$5,230,337
Figure 5, Page 38 Variance multiplied by 0.5	363,824	150,000	527,201	1,317,354
Adjusted Fourth Quarter FY80 Cost Year-To-Date	<u>\$8,398,934</u>	<u>\$10,074,728</u>	<u>\$10,462,400</u>	<u>\$6,547,691</u>
Approximate cost per occupied bed day (Fourth Qtr FY80 Cost YTD divided by Occupied Bed Days)	\$175	\$196	\$272	\$221
Adjusted Cost Per Occupied (Adjusted Fourt Qtr FY80 Cost divided by Total Occupied Bed Days)	\$183	\$199	\$286	\$276
Percent Increase Attributed to Depreciation	4.5%	1.5%	5.0%	25.0%
<u>AMBULATORY CARE</u>				
Total Clinic Visits ²	332,331	401,787	340,082	183,652
Total Ambulatory Care Expenses ²	\$7,444,632	\$8,404,753	\$10,108,776	\$4,584,197
Figure 5, Page 38 Variance multiplied by 0.5	363,834	150,000	527,201	1,217,354
Adjusted Total Expenses	<u>\$7,808,466</u>	<u>\$8,554,753</u>	<u>\$10,635,977</u>	<u>\$5,891,551</u>
Average Cost Per Visit (Total Expenses/Total Visits)	\$21.89	\$20.92	\$30.41	\$24.96
Average Adjusted Cost Per Visit (Adjusted Total Expenses/Total Visits)	\$22.94	\$21.29	\$31.46	\$32.12
Percent Increase Attributed to Depreciation	4.8%	1.8%	5.2%	28.7%

Table 7
Adjusted Average Cost Per Occupied Bed Day
and Per Ambulatory Care Vist

¹ Reference 29

² Reference 30

reason for accounting for depreciation, a medical facility can adjust the total cost of health care delivery. Taking the four NRMCs listed in Table 7 as representative of the degree to which a Military Treatment Facility could influence the recorded cost of health care delivery, it can be seen that by carefully selecting the method of depreciation, estimated useful life, and the depreciable base a Military Treatment Facility can vary its reported cost by as much as 28%. Meanwhile civilian hospitals can alter their depreciation expenses by choosing from among the various depreciation methods. Their choice of which depreciation method to use would depend upon the purpose for which the depreciation expenses are to be used. Generally, civilian hospitals tend to select straight-line depreciation for rate setting and reimbursements while selecting accelerated depreciation for cash flow and tax purposes [Refs. 7, 10, 11, 12, 13, 14].

E. IS THE UCA DEPRECIATION REQUIREMENT SO RESTRICTIVE AS TO MINIMIZE THE EFFECT OF DEPRECIATION ON THE TOTAL COST OF PATIENT CARE?

Iterating what has been said before, depreciation requirements minimize the effect of depreciation on the total cost of patient care; ignoring depreciation expenses ranging from \$300,000 to \$2,600,000 annually certainly decreases the value of the depreciation process in the cost collection system. Using the summary data in Table 5, and data from Reference 28 and 29, Table 8 illustrates the effect of excluding all but

Table 8

**Depreciation's Contribution
to the Total Cost of
Patient Care**

Facility	Adjusted Total¹ Expenses FY1980	Estimated UCA² Depreciation FY 1980	Depreciation's Contribution to Total Expenses
NRMC, Camp Lejeune, NC	\$16,215,400	\$999,636	6.2%
NRMC, Charleston, SC	\$18,644,182	\$768,701	4.1%
NRMC, Long Beach, CA	\$21,151,371	\$1,095,802	5.2%
NRMC, Bremerton, WA	\$12,449,242	\$2,794,420 ³	22.2%

¹ Total Expenses for FY 1980 were taken from References 29 and 30, less UCA depreciation reported for FY 1980, plus the estimated annual depreciation expenses that included all Real Property in the depreciable base.

² Total Depreciation for year, Table 5.

³ Depreciation expense includes the new facility plus all equipment with a dollar value equal to or greater than \$1,000.

modernization and replacement equipment from the depreciable base of a Naval Treatment Facility. It should be noted that the \$2,600,000 variance shown in Table 5 for NRMC Bremerton is attributed to Bremerton being a new facility with the majority of its equipment being new.

F. CAN DEPRECIATION'S CONTRIBUTION TO THE TOTAL COST OF PATIENT CARE BE ISOLATED IN ORDER THAT MANAGEMENT DECISIONS WILL NOT BE INFLUENCED BY SUNK COSTS?

Once depreciation expenses are allocated to the Final Operating Expense accounts, that portion of patient care cost attributable to depreciation can not be isolated. After expense allocation, a reader of UCA summary data would need a copy of a NRMC's expense assignment worksheet similar to Table 12, (Appendix A) in order to isolate depreciation's effect on health care cost.

If one accepts the idea that all past costs are irrelevant and should not be included in future decision [Ref. 31], or if, in the future, UCA includes all capital assets in the depreciable base, then it is important to be able to see what effect depreciation has on patient care cost. If Real Property is included in UCA depreciation procedures, the change in depreciation expenses would be material. Depreciation would then have a material affect on the total cost of patient care. Taking Figure 8 as being representative of all Naval Medical Facilities, depreciation's contribution to the total cost of patient care ranges from 4.1% to 22.2%.

G. CONCLUSION

As stated in the opening paragraph of this chapter, depreciation accounting is a recent occurrence within the military medical services, tracing its origins to the implementation of the Uniform Chart of Accounts. The purpose of UCA depreciation is to account for the consumption of certain long-lived fixed assets as an expense of providing medical care and it is a part of a larger expense accounting system that is designed to account for the total cost of patient care.

As it is currently used in the UCA, depreciation is essentially a composite rate of depreciation. In cases where fully depreciated assets remain in service no further depreciation is taken. Nor, are any adjustments made to recognize an obvious change in an accounting estimate that would affect the amount of depreciation charged to the operating expense accounts such as a change in a medical facility's mix of depreciable equipment that would either increase or decrease their composite service life.

Two factors are the driving force behind the amount of depreciation expense that will be allocated to the various medical care accounts. They are: (1) only modernization or replacement equipment with an acquisition cost equal to, or greater than, \$1,000 will be depreciated, and (2) equipment will be depreciated over an eight year period. Both factors can be challenged on the grounds that they tend to misrepresent

the amount of depreciation expense allocated to the operating expense accounts. As shown by Table 5, including only modernization and replacement equipment seriously understates the amount of expenses generated by depreciation. The second factor, eight year service life, can be questioned based on random samples of equipment from seven NRMCS. These random samples (Appendix B) raise questions as to the validity of the eight-year composite service life. By accepting the premise that equipment used at the various medical treatment facilities comes from identical populations and that the mean useful service life is eight years, one would expect to see a series of random samples where the eight year composite life would fall within a confidence interval for the sample means. Appendix B indicates that while the samples were random and drawn from similar populations the confidence intervals for the mean useful service life had a lower limit of 10.5 and an upper limit of 12.5 years. The eight year composite life falls well outside of the sampling interval and supports the contention that the composite rate of depreciation should be higher than eight years. Considering the availability of data processing equipment, there is really no need to compute a composite service life. Equipment can be depreciated on a straight-line basis.

The UCA depreciation expense allocation does not account for the fact that some clinical services are more equipment-intensive than others. Disregarding this fact and accumulating

all depreciation expenses in a common cost pool and then allocating the accumulated expenses on the basis of either an occupied bed ratio or on a ratio of clinic visits penalized those services that are labor-intensive and have a small investment in depreciable equipment. Labor intensive services are penalized by assigning them a disproportionate share of depreciation expense. According to Ferrara [Ref. 24] and the Cost Accounting Standards Board [Ref. 25] the foregoing inequity can be corrected by charging the using cost center with the depreciation expenses directly identified with its operation. Only when a piece of equipment can not be identified with a particular cost center should it be recorded in a common account and allocated to all cost centers on the basis of either the occupied bed ratio or the ratio of clinic visits.

Finally, unless some changes are made in the UCA accounting procedures, depreciation expenses for FY 1982 and beyond will be overstated by an amount equal to 12.5% of the acquisition cost of equipment with a unit cost that ranges between \$1,000 to \$2,999 purchased with Operating and Maintenance funds.

V. RECOMMENDATIONS FOR CHANGES TO UCA DEPRECIATION

A. INTRODUCTION

Accepting the premise that the purpose of the Uniform Chart of Accounts is to determine the total cost of patient care and that depreciation is a legitimate cost of patient care, there are several changes to the current UCA methodology that are recommended which may improve the accuracy of the cost figures generated by depreciation.

As noted earlier, UCA excludes from the depreciation process a large segment of fixed assets used in the health care delivery process. Nor does the process recognize depreciation attributable to specific cost centers. Additionally, the process underestimates the useful life of equipment and once the depreciation expenses are allocated to the final operating expense accounts, the effect of depreciation on the total cost of patient care can not be isolated unless a copy of the expense assignment worksheet is available. Furthermore, a recent development within Fiscal Year 1981 establishes the ground work for double counting expenses associated with the purchase of equipment with a unit cost that ranges from \$1,000 to \$2,999. All of the foregoing oversights, underestimations and exclusions tend to inhibit the accuracy and usefulness of the expenses generated by depreciation. However, with minor adjustments the accuracy and usefulness of the generated depreciation expenses can be enhanced.

Accounting for depreciation as an element of the cost of health care delivery can be improved in five ways: (1) include all capital assets that exceed the depreciation threshold in the depreciation process, (2) allocate depreciation expenses on a direct basis as well as indirectly, (3) depreciate capital assets using a unit straight-line depreciation method, (4) display depreciation expenses for the final operating expense accounts in a format that shows what portion of the total expenses are attributable to depreciation, (5) utilize adjusting entries at the end of each UCA reporting period to avoid double counting expenses associated with the purchase of equipment in the \$1,000 to \$2,999 range.

B. RECOMMENDATIONS

1. Include All Capital Assets in the Depreciation Process

a. The accuracy of determining the value of capital assets consumed in the process of providing health care can be improved if all assets that exceed the depreciation threshold are included in the depreciation process, irrespective of the source of funds used to purchase the assets.

b. Depreciation can be accumulated in two accounts: Real Property Account (to include buildings, land improvements, utilities, elevators and alarm systems) and Equipment Account. In addition to equipment with a value greater than \$1,000, the Equipment Account would include patient and office furniture that exceeds the depreciation threshold value.

c. Once depreciation expenses are collected they can be allocated on the basis of square footage of building occupied in the case of real property, or on the basis of either a ratio of occupied bed days or a ratio of ambulatory care visits.

2. Use Two Methods of Allocating Depreciation to Either the Inpatient Care Accounts or to the Ambulatory Care Accounts

a. Treat depreciation as either a direct or indirect cost depending on its traceability to a particular cost center. If the total use of a piece of equipment is traceable to a particular cost center then the resulting depreciation should be allocated to the using cost center. If, however, the piece of equipment can not be easily identified with a particular cost center, then the depreciation should be treated as an indirect cost and allocated to the final expense accounts on the basis of either a ratio of occupied bed days or a ratio of ambulatory care visits.

b. Treating depreciation as either a direct or indirect cost will more closely show the full cost of operating a cost center. Dealing with depreciation as an indirect cost, assignable only on a prorated basis, understates the cost of operating equipment-intensive cost centers while at the same time overstating the cost of those cost centers that are labor-intensive. Whereas depreciation as a direct cost will reduce this inequity and assign the cost of asset consumption to the producing department.

c. Assign real property depreciation as an indirect expense to the corresponding Real Property depreciation account. Accumulated expenses can then be allocated on the basis of square footage of building(s) occupied by the various cost centers.

d. Allocating depreciation expenses utilizing the foregoing methods will help determine the total amount of resources used by a cost center, with the full depreciation cost being the sum of its direct depreciation expenses plus an equitable share of the indirect depreciation expenses. The general principle being that each cost center should be charged with the full amount of the cost that they cause. In essence, cost centers will receive those depreciation expenses that can be traced directly to them as well as an equitable share of the depreciation expenses incurred jointly for two or more cost centers.

3. Depreciate All Capital Assets Using a Unit Straight-line Method

a. In place of a composite rate of depreciation, all capital assets can be depreciated using the unit straight-line method. Depreciating each capital asset based on the individual useful service life eliminates the need to make several strong assumptions associated with the composite rate of depreciation. Primarily, the need to assume that the useful life of the equipment is normally distributed throughout the population and has a mean life expectancy of eight years,

retired assets are replaced with assets having similar useful lives and there will be no material change in the composition of assets will be eliminated.

b. Additionally, the unit straight-line depreciation method will more closely match the expected consumption of the assets over time than will the current composite rate of depreciation. In the event a fully depreciated asset is still in use, the unit straight-line method will permit a Naval medical facility to adjust the useful service life to reflect the revision in useful service life as well as revision of an accounting estimate. Both adjustments would be an improvement over the current method which assumes all assets are considered to be fully consumed after eight years.

c. Depreciating assets on a unit basis and adjusting the service life for fully depreciated assets still in use parallels the depreciation policy set forth by the Assistant Secretary of Defense (Comptroller) Memorandum dated 6 November 1979 outlining the Department of Defense's depreciation policy. The memorandum states in part that, "... the straight line method of depreciation is appropriate when the expected consumption of the asset is reasonably level over the useful life of the asset ... Assets that are still in use will not be fully depreciated ... the estimated life of an asset will be reviewed and adjusted periodically to conform to current plans for (the) asset's usage ..."

4. Display Depreciation in a Format that Shows the Effect of Depreciation on the Total Operating Expenses

a. After depreciation has been allocated to the final operating expense accounts a reader of summary data can not tell what effect depreciation has on the total cost of providing health care. This inability to separate a sunk cost from the total cost of providing health care could result in management decisions being influenced by an irrelevant cost. In such areas as deciding on the desirability of providing a medical service or purchasing the same service from a civilian health care facility, or in comparing relative efficiencies between Naval medical facilities, incorporating an irrelevant cost in the comparative cost analysis could persuade management that it was cheaper to purchase health care rather than provide the service in-house, or decide that one Naval medical facility was more efficient than another when in fact the margin of difference in each case was attributable to a sunk cost like depreciation.

b. Reporting depreciation as a separate column on either the Medical Expense Performance Report or on other reports such as the UCA Analysis of Inpatient Care and Ambulatory Care [Refs. 29,30] and will decrease the chance that management decisions will be influenced by a sunk cost. Modification of the UCA collecting and reporting system could lead to the production of a report similar to Table 9. Table 10 is the format typically used to report medical expenses.

Table 9
**DOD MEDICAL EXPENSE AND PERFORMANCE REPORT
 (PROPOSED)**

Inpatient Care	Dispositions	Occupied Bed Days	Bed Day Ratio (%)	Total		Clinician Expenses	Operating Expenses	Total Expenses
				Depreciation Expense	1/			
Medical Care	1,087	6,084	17.2	\$29,756	\$77,665	\$1,772,019	\$1,879,440	
Surgical Care	1,717	7,437	21.0	36,330	244,991	1,988,330	2,249,651	
Obstetrical/Gyn	2,416	7,889	22.3	38,579	62,235	1,927,143	2,027,957	
Pediatric Care	2,183	6,730	19.0	32,870	30,010	1,050,881	1,113,761	
Orthopedic Care	765	4,271	12.1	29,933	14,135	775,208	810,276	
Psychiatric Care	366	2,982	8.4	11,532	55,841	367,235	437,608	
Total	8,1534	35,393	100.0	\$173,000	\$464,877	\$7,808,815	\$8,518,693	
Ambulatory Care		Total Visits	Ratio Outpatient Visits (%)	Depreciation Expense	Operating Expenses	Total Expenses		
Medical Care	23,341	7.3		\$12,629	\$ 860,432	\$ 873,111		
Surgical Care	26,008	8.1		14,013	568,337	582,350		
Obstetrical/Gyn	64,103	20.0		34,600	745,511	780,111		
Pediatric Care	33,917	10.6		18,338	556,451	574,789		
Orthopedic Care	13,712	4.3		7,439	329,391	336,830		
Psychiatric/								
Mental Health	10,263	3.2		5,539	204,622	210,161		
Family Practice	40,308	12.6		21,797	927,642	949,439		
Primary Medical Care	83,477	26.0		44,4980	2,072,054	2,117,034		
Emergency Medical Care	25,408	7.9		13,665	906,892	920,557		
Total	320,537	100.0		\$173,000	\$7,201,382	\$7,317,382		

1/ Total depreciation expense is the sum of depreciation assigned as a direct cost to the final operating expense account plus indirect depreciation expense allocated on the basis of the appropriate ratio. Indirect depreciation expense YTD = \$346,000 with 50% assigned to inpatient care and 50% assigned to ambulatory care.

NOTE: In this particular example no direct depreciation expense was assigned to any patient care account.

DOD MEDICAL EXPENSE AND PERFORMANCE REPORT ¹		See Instructions in Chapter 5 of DOD 6010.10 M		RCS
NAME AND ADDRESS OF FACILITY (Include ZIP Code)		FACILITY CODE (WIC)		REPORT PERIOD
REPORTING AUTHORITY Navy - Bureau of Medicine and Surgery		DOD MEDICAL REGION 13		Cumulative YTD
PART I - DIRECT PATIENT CARE (Direct Expenses Plus Support and Ancillary Services Assignments and Performance)				
INPATIENT CARE		DISPOSITIONS	TOTAL EXPENSES INCLUDING CLINICIAN SALARY	CLINICIAN SALARY EXPENSE
MEDICAL CARE		1,087	\$1,879,440	\$77,665
SURGICAL CARE		1,717	2,249,651	224,991
OBSTETRICAL/GYNECOLOGICAL CARE		2,416	2,027,957	62,235
PEDIATRIC CARE		2,183	1,113,761	30,010
ORTHOPEDIC CARE		765	810,276	14,135
PSYCHIATRIC CARE		366	437,608	55,841
TOTAL		8,534	\$8,518,693	\$464,877
AMBULATORY CARE		TOTAL OUTPATIENT EXPENSES	OUTPATIENT VISITS	INPATIENT VISITS ²
MEDICAL CARE		\$ 873,11	22,368	973
SURGICAL CARE		582,350	24,677	1,331
OBSTETRICAL/GYNECOLOGICAL CARE		780,111	64,103	0
PEDIATRIC CARE		574,785	33,917	0
ORTHOPEDIC CARE		336,830	12,076	1,636
PSYCHIATRIC/MENTAL HEALTH CARE		210,161	10,179	84
FAMILY PRACTICE CARE		949,439	40,308	0
PRIMARY MEDICAL CARE		2,117,034	83,477	0
EMERGENCY MEDICAL CARE		920,557	25,408	0
FLIGHT MEDICINE CARE		--	--	--
UNDERSEAS MEDICINE CARE		--	--	--
TOTAL		\$7,344,378	316,513	4,024
DENTAL CARE	TOTAL EXPENSES	WEIGHTED DENTAL PROCEDURE	WEIGHTED DENTAL PROSTHETIC WORK UNIT	
DENTAL SERVICES	\$133,083		NA	
DENTAL LABORATORIES (Class 2 and 3 Only)	13,220	NA		
TOTAL	\$146,303			

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¹ SEE ATTACHED CAVEATS
² EXPENSES INCLUDED IN INPATIENT CARE ACCOUNTS

Table 10

NAVCOMP 2171 Functional Category/Expense Element
Report Reconciliation with UCA Expenses

Table 10

(Continued)

(000)

Expense from the NAVCOMP 2171 Report

Year-To-Date	\$18,780.8 ¹
+ Free Receipts	15.2
+ Depreciation	345.8
+ Borrowed Labor	26.9
- Unauthorized Absence Labor	(10.0)
- Loaned Labor	(52.3)
- Direct Reimbursable Expenses	<u>(16.0)</u>
Total Expenses Reported on this MEPR	<u>\$19,090.4</u>

¹Year-to-Date Expenses Total was taken from the Functional Category/Expense Report (NAVCOMP 2171) prepared by the Authorized Accounting Activity.

It summarizes the health care delivery expenses and reconciles the UCA expense with the Resource Management System's Function Category/Expense Element Report (NAVCOMP 2171). Table 9 refines the Medical Expense and Performance Report and displays depreciation expense along side the appropriate patient care account. The formats proposed in Tables 9 and 10 will allow an analyst the opportunity to decide whether or not depreciation was a relevant cost to be used in any comparative cost analysis. Isolating depreciation from the total expense of providing health care takes on added significance in the event all capital assets are included in the depreciation process. The added significance is attributable to the increase in depreciation's contribution to the total cost of health care brought about by incorporating all capital assets in the depreciation base.

5. Use Adjusting Entries at the End of Each Reporting Period to Avoid Double Counting Expenses

a. The amount of expenses allocated to a cost center that comes from purchasing equipment with a unit price that ranges between \$1,000 and \$2,999 can be subtracted from the operating expenses for that cost center before the UCA step-down allocation process begins. Making the adjusting entries has advantages over raising the depreciation threshold value to \$3,000. The chief advantages are: (1) data reported will be consistent with prior year reports; (2) adjusting entries will eliminate the need to maintain two property accounting

systems, one system to account for property in the \$1,000 to \$2,999 range previously expensed and another system to account for equipment in the same range that is subject to depreciation.

b. Additional support for making adjusting entries comes from the Comptroller General's accounting guidelines for Federal Agencies [Ref. 25] Raising the depreciation threshold value to \$3,000 would exceed the Comptroller General's guidelines for capitalization of fixed assets by a factor of ten [Ref. 22] According to the Comptroller General's accounting guidelines for Federal Agencies, "Fixed assets owned or acquired by each agency shall be capitalized in its accounts ... it is appropriate to establish reasonable dollar minimums as a basis for excluding certain property units from capitalization. No minimum in excess of \$300 should be established ..." [Ref. 22] Considering that capitalized assets form the foundation for depreciation accounting, it would appear that raising the depreciation threshold value in the UCA to \$3,000 would exceed the foregoing guidelines established by Comptroller General by a much wider margin than can be justified.

VI. SUMMARY AND CONCLUSION

A. SUMMARY

Depreciation, as a cost of providing health care, became an integral part of a cost collection system that was implemented in the Department of Defense in 1979. Known as the Uniform Chart of Accounts (UCA), the system's purpose was to record, accumulate and report information regarding expenses and workloads within the various military treatment facilities as a means of determining the full cost of treating a patient. Among the benefits expected to be gained from knowing the full cost of patient care are enhanced cost awareness, cost-effectiveness evaluation, improved decision-making and improved cost comparability among the military treatment facilities as well as with the civilian health sector.

Under the UCA, depreciation is used to allocate the cost of the fixed assets used in the health care delivery process in a systematic and rational manner. The type of depreciation used is a composite straight-line method that assumes all assets are either modernization or replacement equipment. Specifically excluded from the UCA depreciation accounting are new and expanded facilities, real property, War Readiness Reserves and expenses associated with the support of such special programs as vehicles, clinical investigations, drug and alcohol abuse programs.

Once accumulated, depreciation expenses are allocated to the final UCA expense accounts on the basis of a ratio of occupied bed days for a particular inpatient account to the total number of occupied bed days for the facility. The final ambulatory care expense accounts receive their portion of the depreciation expenses based on a ratio of ambulatory clinic visits to the total number of a facility's ambulatory clinic visits.

Several factors are taken for granted in computing depreciation under the UCA. They are: (1) the useful life of depreciable equipment is distributed normally throughout the equipment population and have a mean life expectancy of eight years, (2) replacement equipment have useful lives similar to the equipment being taken out of service, (3) only modernization and replacement equipment with a value greater than \$1,000 contributes to the expense of providing medical care in a military treatment facility.

Depreciation use varies markedly between the Military Health Service System and the Civilian Health Care System. Essentially there are two major differences. First, the Military Health Service System used a uniform method of depreciation that ensures all of the military facilities accumulate and distribute depreciation expenses in a uniform manner, whereas civilian hospitals use a variety of depreciation methods depending on the purpose for accumulating depreciation expenses. For example, if a civilian hospital accumulates

depreciation for the purpose of generating cash flow, it will probably choose an accelerated method of depreciation [Ref. 10]. However, if the civilian hospital's purpose is accumulating depreciation in order to determine a contractual reimbursement rate, it will choose straight-line depreciation [Ref. 28]. The second major difference is that the Military Health Service System ignores a substantial portion of its depreciation expenses by excluding real property and new or expanded facilities in the depreciation process. While, on the other hand, the civilian hospitals will include any item that has a useful life greater than one year and whose cost exceeds the dollar threshold established by law or administrative regulation. An example of an administrative regulation that establishes a depreciation threshold value is the \$100 minimum established by the California Health Facilities Commission's Hospital Accounting and Reporting Manual, [Ref. 28].

While the UCA depreciation methodology systematically accumulated and allocates the consumption of long-lived assets used in the health care delivery process, it has several drawbacks that detract from its usefulness. Firstly, not all capital assets are included in the depreciation process. A substantial portion of a military treatment facility's depreciable assets are ignored, consequently understating the full cost of patient care. Secondly, a composite rate of depreciation is used that overstates the rate at which assets are consumed by as much as 50% (Figure 13, Appendix B).

Thirdly, depreciation is inequitably allocated to labor-intensive cost centers. As a result of not being able to charge depreciation directly to a using cost center, the UCA overstates expenses for the labor-intensive cost centers while at the same time understating expenses for equipment-intensive cost centers. Fourthly, depreciation's effect on total operating expenses can not be isolated once depreciation has been allocated to the final expense accounts. The inability to isolate depreciation's effect on total operating expenses can lead to management decisions being unduly influenced by sunk costs. Finally, expenses associated with the purchase of equipment in the \$1,000 to \$2,999 range are being double counted in the expense allocation process. The amount of the double counting will be approximately 12.5% per year of the total dollar value of the equipment in the \$1,000 to \$2,999 range that was put in service during the year.

B. CONCLUSION

In determining the full cost of providing patient care, it is essential that the cost of the capital assets used in the health care delivery process be taken into consideration. The Uniform Chart of Accounts' approach is a good starting point in allocating the cost of capital assets to the final operating expense accounts. However, with some adjustments it is felt that additional benefits can be gained from the

accumulation and subsequent allocation of depreciation expenses. If the UCA will include all capital assets that exceed the dollar threshold in the depreciation process, irrespective of asset classification or source of funding, and depreciate all capital assets on a unit straight-line basis the resulting expenses will more closely equal the total cost of health care delivery. Additionally, the military treatment facilities depreciation expenses will more closely parallel those of the civilian health care sector. Another adjustment that would benefit the cost collection system would be to allocate depreciation as a direct expense when a piece of equipment or a building can be identified with a particular cost center. For those pieces of equipment or buildings whose use is ubiquitous to the treatment facility, depreciation can be allocated on the basis of square footage of building occupied, or on a ratio of either occupied bed days or a ratio of ambulatory clinic visits. Double counting of equipment expenses can be avoided if adjusting entries are made to the NAVCOMP 2171, Functional Category/Expense Element Report, to remove the value of equipment in the \$1,000 to \$2,999 range that was purchased during the reporting period. Redesigning the Department of Defense Form 2202, Medical Expense and Performance Report, to show the effect that depreciation has on the cost of providing health care would also be beneficial. Displaying depreciation as a separate column on the Medical Expense and Performance Report similar

to the way that clinician salary expenses are currently shown will not only show the effect depreciation has on the total cost of patient care, but it will also help management avoid being unduly influenced by a sunk cost when making a cost-benefit analysis.

The foregoing adjustment will make depreciation accounting more beneficial to the Uniform Chart of Accounts and make cost comparisons between the military treatment facilities and the civilian health sector more meaningful. There is however, another area of UCA depreciation accounting that would benefit from additional study. Such an area would be in the area of automated property accounting. A researcher using the U. S. Army Medical Department Property Accounting System as a model may be able to adapt that system to the Navy Medical Department or devise a system that, from a single data base, would perform property accounting, automatically schedule biomedical equipment maintenance, and forecast future asset requirements at a prospective replacement costs. A subfunction of such a system would be an improved method of accumulating depreciation expenses.

APPENDIX A
UNIFORM CHART OF ACCOUNTS
FOR
FIXED MILITARY MEDICAL AND DENTAL TREATMENT FACILITIES

Throughout this study frequent reference will be made to the use of depreciation as a summary account within the Uniform Chart of Accounts for Fixed Military Medical and Dental Treatment Facilities (UCA). As an aid to understanding the effect that the UCA has on a military medical treatment facility's expense collection and reporting, a brief description of the system is in order. Out of necessity the description of the Uniform Chart of Accounts will be brief. It will deal only with those features of the UCA that the author feels are essential to understanding the workings of the system. Those readers desiring a more detailed description of the Uniform Chart of Accounts are invited to read the Department of Defense Instruction 6010.10M where the subject of this appendix is dealt with at great length.

A. DESCRIPTION¹

The Uniform Chart of Accounts is an expense collection and reporting system that allocates patient care cost to six

¹Unless otherwise indicated, the bulk of the information about the Uniform Chart of Accounts was extracted from Department of Defense Instruction 6010.10M [Ref. 4].

functional accounts: Inpatient care, Ambulatory Care, Dental Care, Ancillary Services, Support Services, and Special Programs. Each functional account is further divided into summary and subaccounts (Figure 2).

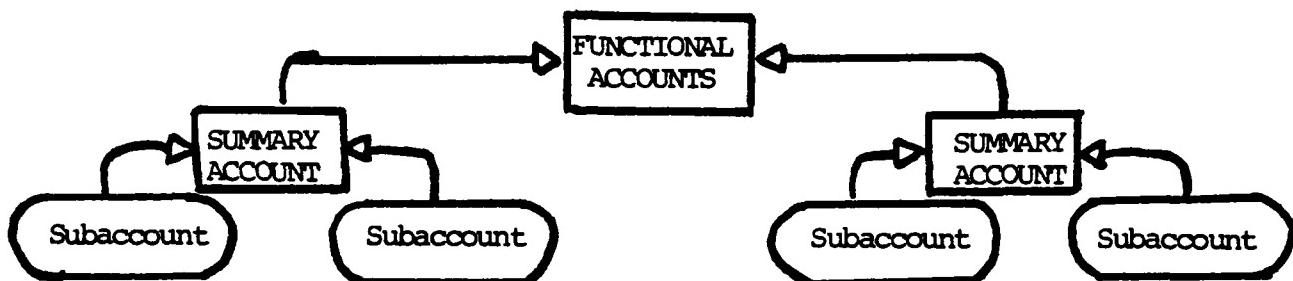


Figure 2

Two functional accounts, Support Services and Ancillary Services are intermediate operating accounts. The other four functional accounts are final expense accounts. Expenses collected in intermediate accounts are allocated to the final accounts via a step-down process that is based on either performance factors or units of service measurements. The UCA is arranged in a hierarchy in which the functional accounts appear at the top and subaccounts are at the bottom.

Regardless of their position in the hierarchy, there are four elements that are common to all accounts:

1. Function Element

Contains a description of the type of activity characteristic of the account. The functional description tells what type and level of services were provided, administrative duties performed and such other data as required to clearly

distinguish between accounts in order to facilitate the rational accumulation of cost data and work performance measurements.

2. Cost Element

Identifies the operating expenses incurred in operating and maintaining a discrete functional or organizational subdivision (workcenter) of a military medical facility.

3. Performance Element

A measure of work produced by a work center, i.e., patient visit, occupied bed day, square footage of building occupied, weighted procedure, etc.

4. Assignment Procedure

A method of cost allocation that distributes the operating expenses of the two intermediate operating expense accounts to the final operating expense accounts.

As a means of assisting in the understanding of the UCA classification a brief description will be given as to how functional accounts, summary accounts, and subaccounts are classified.

a. Functional Accounts

(1) Inpatient Care account provides for the examination, diagnosis, treatment, and disposition of inpatients. Inpatients are those individuals who are admitted to a bed in a medical treatment facility which has authorized or designated beds for inpatient medical or dental treatment. This is an account into which all operating expenses of the seven major inpatient care summary accounts, Medical Care, Surgical Care,

Obstetrical and Gynecological Care, Pediatric Care, Orthopedic Care, Psychiatric Care, and Ophthalmology and Otorhinolaryngology Care are summarized. This summarization represents the total cost of inpatient care. The performance factor used to measure the work produced is the occupied bed day.

(2) Ambulatory Care accounts provide for accumulation of expenses associated with patient care relative to professional advice and consultation, examination, diagnosis, treatment and disposition of all categories of inpatients and outpatients² presenting themselves to the various ambulatory clinics. The Ambulatory Care account is an account into which all of the operating expenses associated with the major Ambulatory Care summary accounts are summarized (refer to page 81 for a listing of major ambulatory care accounts).

(3) Dental Care account provides for the summarization of expenses associated with delivering comprehensive dental care to armed forces members, certain former members (subject to availability of space and capabilities of the staff) and providing dependent dental care in certain well defined circumstances. This is a final operating expense account which shall include all of the operating expenses incurred in operating and maintaining Dental Centers and

²An outpatient is an individual receiving health care for an actual or potential disease or injury that does not require admission to a medical treatment facility for inpatient care.

Clinics. There are no specific performance measures for this functional account.

(4) Ancillary Services account accumulates the summarized expenses associated with those activities that participate in the care of patients principally by assisting and augmenting the talents of the attending physician and dentist in diagnosing and treating human ills. Generally, ancillary services do not have primary responsibility for the management of patients. Rather, patient services are provided on order of the attending physician or dentist. The Ancillary Service account shall be a summary account which will include all of the operating expenses summarized in the major ancillary summary accounts listed on page 82 paragraph (4). It should be noted that the order of accounts listed in paragraph (d) is identical to the order of the step-down process used to allocate expenses to the final operating expense accounts. The performance factor used to measure workload are weighted procedures [Ref. 4].

(5) Support Services account is provided to accumulate the expenses necessary to direct and support the mission assigned to the medical treatment facility. With the exception of the Depreciation account, Support Services perform the management and administrative functions of Ref. 12:

Command and Administrative Support Service

Personnel Support Service

Public Works

Material Service
Housekeeping and Janitorial Services
Biomedical Equipment Repair
Linen and Laundry Service
Inpatient Food Service
Ambulatory Care Administration

This account will summarize all of the operating expenses of the major support services, including depreciation, outlined above. It will be noted that when Depreciation is placed at the top of the list of accounts outlined above, the listing is identical to the order of step-down used during the assignment of expenses to the final operating expense accounts. There are no performance factors associated with this account since the Support Services account is used only as a summary account in which to totalize and report cost of the major inclusive accounts.

(6) Special Programs account summarizes the expenses of a military treatment facility which are incurred as a result of performing those portions of its mission other than direct patient care. This account is essential in order to preclude these expenses from being charged to the facility's direct patient care accounts. Paragraph 3a, page 7 contains a listing of the primary summary accounts associated with this functional account. Since this account exists only as a repository of summarized expenses from the primary summary accounts associated with Special Programs, there is no associated performance factor.

b. Summary Accounts and Subaccounts

(1) Summary accounts are the second level of the UCA hierarchy and services as a collection point for cost data. As indicated by their names, summary accounts generally coincide with the services that are performed by the treatment facility. The number of summary accounts in each functional account ranges from one in Dental Care to eleven in Ambulatory Care. Generally the summary accounts are self-explanatory and the discussion about them in this paper will be limited to listing the summary accounts under their general functional heading. If a more detailed explanation is desired, the reader is invited to read the applicable portions of the Department of Defense Instruction 6010.10 (series).

(2) Subaccounts are the lowest level of accounts in the UCA hierarchy. They are generally accounts that are identifiable performance units [Ref. 12]. Subaccounts can be established in any manner deemed appropriate by the facility commander. These accounts are used to accumulate the initial operating expenses associated with a workcenter. They are used to meet diverse internal needs of the various military medical treatment facilities. The only constraints on subaccounts are that they be assigned to the proper summary account during the reassignment and summarization process [Ref. 12]. Subaccounts make the UCA sufficiently flexible to allow the identification of expenses with an individual unit or as a means of aggregating operating expenses into a common pool for allocation to the proper summary accounts.

c. Account Listings According to Function

The following accounts are listed in hierachial order. That is, the major heading is the function account, followed by the summary account, and finally the subaccount is listed. As a means of illustration and in the interest of brevity, subaccounts will only be listed for the Inpatient Care and Ambulatory Care summary account "Medical Care". A more detailed listing of subaccounts is contained in the Department of Defense Instruction 6010.10M, "Uniform Chart of Accounts for Fixed Military Medical and Dental Treatment Facilities". For example, the Internal Medicine subaccount would be listed under the functional account Inpatient Care and the summary account Medical Care:

(1) Inpatient Care (functional account)

(a) Medical Care (summary account)

Internal Medicine (subaccount)

Cardiology

Coronary Care Unit

Dermatology

Endocrinology

Gastroenterology

Hematology

Intensive Care (Medical)

Nephrology

Neurology

Oncology

Pulmonary/Upper Respiratory Disease

Rheumatology

Medical Care Not Elsewhere Classified

- (b) Surgical Care
- (c) Obstetrical and Gynecological Care
- (d) Pediatric Care
- (e) Orthopedic Care
- (f) Psychiatric Care

(2) Ambulatory Care

- (a) Emergency Medical Care
- (b) Flight Medicine Care
- (c) Family Practice Care
- (d) Medical Care

Internal Medicine Clinic

Allergy Clinic

Cardiology Clinic

Dermatology Clinic

Diabetic Clinic

Endocrinology (metabolic) Clinic

Gastroenterology Clinic

Hematology Clinic

Hypertension Clinic

Nephrology Clinic

Neurology Clinic

Nutrition Clinic

Oncology Clinic

Pulmonary Disease Clinic

Rheumatology Clinic

Medical Clinics Not Elsewhere Classified

- (e) Obstetrical and Gynecological Care
- (f) Orthopedic Care
- (g) Pediatric Care
- (h) Primary Medical Care
- (i) Psychiatric/Mental Health Care
- (j) Surgical Care

(3) Dental Care

- (a) Dental Service
- (b) Type 3 Dental Prosthetic Laboratory
- (c) Type 2 Dental Prosthetic Laboratory

(4) Ancillary Services

- (a) Pharmacy
- (b) Pathology
- (c) Radiology
- (d) Special Procedures Service
- (e) Central Sterile Supply/Material Services
- (f) Surgical Service
- (g) Same Day Service
- (h) Rehabilitative Services
- (i) Nuclear Medicine

(5) Support Services

- (a) Depreciation
- (b) Command and Administrative Support Services
- (c) Personnel Support Services
- (d) Public Works
- (e) Material Services
- (f) Housekeeping and Janitorial Service
- (g) Biomedical Equipment Repair
- (h) Linen and Laundry Service
- (i) Inpatient Food Service
- (j) Inpatient Affairs
- (k) Ambulatory Care Administration

(6) Special Programs

- (a) Specified Health Related Programs
- (b) Public Health Service
- (c) Health Care Services Support
- (d) Military Unique Medical Activities
- (e) Patient Movement and Military Patient Administration

B. EXPENSE REASSIGNMENT PROCEDURE

Expenses incurred for support and ancillary services are allocated to the final operating expense accounts by a cost assignment methodology that contains five steps. They are:

Step 1: Non-personnel direct expenses and performance data are assigned to the appropriate intermediate and final operating expense accounts.

Step 2: Full-time equivalent man-months and salary expenses are distributed to the intermediate and final operating expenses.

Step 3: A pre-step down purification of cost within and to medical treatment facility accounts' is done within this step. Many of the support and ancillary services accounts require that the expense charged to an account be prorated based on a unit of service, performance factor or other criteria. This step-down can be done during Step 3 as a purification procedure before step-down or by the allocation process of Step 4. If the expense in question does not include overhead expenses then Step 3 is used. If the cost to be allocated includes overhead expenses then the cost allocation procedures of Step 4 should be used. Purification is the process of reassigning expenses from one operating expense account to one or more other operating expense accounts with the sole objective of recognizing the benefitting function or activity for which the work was performed. Purification during Step 3 will not include any expenses reassigned from other accounts. Any reassignment of stepped-down expenses will be done in Step 5.

Step 4: Expenses of the intermediate operating expense accounts and cost pools are assigned through a step-down process to the final operating expense accounts during this step.

Step 5: Post-step-down purification of the final operating expense accounts is done during this step. Based on a performance factor or unit of service, stepped-down expenses assigned to final operating expense accounts can be reassigned to another expense account. For example, inpatient or ambulatory expenses may be charged to a special program account such as the Alcohol and Drug Abuse/Rehabilitation program account. If there is a purification (reassignment) of expenses from Ambulatory Care to a Special Program account there must be a corresponding reduction in the number of visits reported by the Ambulatory Care account. The number of occupied bed days reported by the Inpatient Care accounts will not be affected by any reassignment of expenses to or from Inpatient Care accounts.

Table 11 is an example of a truncated expense assignment worksheet that illustrates the step-down procedures used to allocate expenses from the intermediate expense accounts to the final accounts.

After the allocation procedures have been completed and the intermediate expense accounts are closed, a Medical Expense and Performance Report is submitted to the Office of the Surgeon General. This report is submitted on a quarterly basis. It consists of five parts, Parts I through IV provide statistical data and Part V provides for a narrative summary.

Table 11
Truncated Expense Assignment Worksheet

INTERMEDIATE OPERATING EXPENSES ACCOUNTS		OPERATING DEPRECIATION EXPENSES OF EQUIPMENT		HOUSEKEEPING & JANITORIAL		LINEN & LAUNDRY		INPATIENT FOOD SERVICE		PHARMACY		PATHOLOGY		RADIOLOGY		TOTAL EXPENSES	
<u>SUPPORT SERVICES</u>																	0
Depreciation	11000	11000	0	90000	90000	0	93900	93900	0	0	0	0	0	0	0	0	
Housekeeping & Janitorial	90000	0	0	200	200	0	4000	4000	0	0	0	0	0	0	0	0	
Linen & Laundry	93700	0	0	5000	5000	0											
Inpatient food service	215000	0	0														
<u>ANCILLARY SERVICES</u>																	
Pharmacy	752800	0	0	0	0	0	1000	1000	0	753800	753800	0	0	0	0	0	0
Pathology	254500	0	0	500	500	0	3000	3000	0	260000	260000	0	0	0	0	0	0
Radiotherapy	140000	0	0	500	500	0	2000	2000	0	500	500	0	0	0	0	0	0
<u>FINAL OPERATING EXPENSE ACCOUNTS</u>																	
<u>INPATIENT CARE</u>																	
Medical Care	90000	2000	15000	25000	25000	48000	18000	18000	45000	45000	2000	407000	0	0	0	0	0
Internal medicine	45000	1000	6000	5000	5000	4700			6000		3000	887000	0	0	0	0	0
Dermatology																	
Surgical Care																	
General Surgery	110000	3000	15000	30000	30000	45000	17000	17000	65000	65000	3000	441000	0	0	0	0	0
Urology	45000	500	6000	7000	7000	4500			7000		4000	91000	0	0	0	0	0
<u>AMBULATORY CARE</u>																	
Medical Care	115000	1200	8000	10000	10000	0	90000	90000	0	33000	33000	0	291200	0	0	0	0
Internal Med. Clinic	35000	400	3000	400	400	0	20000	20000	0	10000	10000	0	708000	0	0	0	0
Hematology Clinic																	
Surgical Care																	
General Surg. Clinic	100000	1200	8000	10000	10000	0	75000	75000	0	40000	40000	0	250200	0	0	0	0
Neurosurgery Clinic	250000	200	3000	6000	6000	0	130000	130000	0	20000	20000	0	658000	0	0	0	0
Pediatric Care	120000	100	9000	2080	2080	0	110000	110000	0	36000	36000	0	307100	0	0	0	0
<u>DENTAL CARE</u>																	
Dental Service	150000	1200	9500	9500	9500	0	30000	30000	0	0	0	0	0	204000	0	0	0
Dental Pros Lab	50000	200	500	500	500	0								51200	0	0	0
<u>SPECIAL PROGRAMS</u>																	
Clinical Investigation	10000	0	200	100	100	0	5000	5000	0	7500	7500	0	24800	0	0	0	0
Training & Education Program	120000	0	500	1500	1500	0	7000	7000	0	9000	9000	0	142000	0	0	0	0
Nonpatient food services	0	0	0	0	0	0	121800	121800	0	0	0	0	0	121800	0	0	0
Communications	100000	0	100	300	300	0	15000	15000	0	0	0	0	0	25400	0	0	0
<u>TOTAL</u>	2582000	110000	90000	224000	93900	0	753800	753800	0	260000	260000	0	144800	0	0	0	0

C. CONCLUSION

As stated at the beginning, this description of the Uniform Chart of Accounts is admittedly cursory in scope. However, it is hoped that the brief explanation was sufficient to provide a basic understanding of the UCA to those familiar with the Uniform Chart of Accounts for Military Medical Treatment Facilities.

APPENDIX B
STATISTICAL ANALYSIS OF THE UNIFORM CHART OF ACCOUNTS
COMPOSITE RATE OF DEPRECIATION

A. INTRODUCTION

A basic assumption underlying the use of a composite life of eight years is that the eight years is representative of the average asset's useful life and that there have been no material changes in either the composition of assets or in the assets service lives [Ref. 9]. As a test of the validity of the eight-year assumption a series of 5 samples of size 30 were drawn from the equipment inventory lists from seven Naval Regional Medical Centers (NRMIC). Samples from five of the NRMICs were from the Equipment File List dated December 1979 on file at the Bureau of Medicine and Surgery, Navy Department, Washington, DC. Samples for the NRMIC, Long Beach, CA were taken from that facility's Master Property List as of 8 June 1980. NRMIC, Camp Lejeune, NC samples were drawn from the Item Category Report of equipment to be included in the new facility under construction.

The tests that were done on the samples were computations for means, standard deviations, confidence intervals, Runs Test for Randomness, and a Kruskall-Walls One-Way Analysis of Variance.

Except for NRMIC Long Beach, CA each sample was drawn over an interval where 30 items would be selected from the

facility's equipment list. NRMC Long Beach's samples were drawn using a simple random sampling technique. Interval sampling was selected as the primary means of obtaining samples because of its simplicity and ease with which it could be used with the format of the equipment list from which the samples would be drawn. Interval sampling is the simplest selection technique to use, and if used with care, it can provide a reasonable degree of assurance that the sample had been selected at random [Ref. 29].

B. MEAN, STANDARD DEVIATION, AND CONFIDENCE INTERVAL

Samples were drawn from the foregoing listings. A mean, standard deviation and confidence interval was calculated for each sample. Sample means were calculated as using the formulas outlined in Wonnacott [Ref. 32].

$$\bar{x} = \frac{1}{n-1} \sum_{i=1}^n x_i$$

variance:

$$s^2 = \frac{1}{n-1} \sum_{i=1}^n (x_i - \bar{x})^2$$

Standard Deviation: $s = \sqrt{\text{Variance}}$

Confidence Interval: $CI = \bar{x} \pm t_{.025} \frac{s}{\sqrt{n}}$

where:

x_1 = estimated useful service life of each item

n = number of items in the sample ($n = 30$)

$r_{.025}$ = Student's t variable for a confidence interval at 95%

Table 14 shows the results of the foregoing computations.

C. RUNS TEST FOR RANDOMNESS

As a means of verifying that the samples were selected at random a series of Runs Test for Randomness were performed.

Using the sample means a Runs Test for Randomness [Ref. 34] were performed to determine if the samples were truly selected at random. The null hypothesis H_0 being that the samples were drawn at random. According to Wonnacott [Ref. 34], when H_0 is true the path of the observations crosses the sample median frequently; pergo when H_0 is not true this happens much less frequently. Accept H_0 if and only if prob-value is greater than 5%.

In general there are 30 observations in each sample. When H_0 is true, the distribution of the number of Runs (r) is approximately normal with an expected mean value of:

$$E(R) = \frac{n}{2} + 1 \quad \text{Where } n = \text{the number of items in the sample}$$

The expected Variance of the Runs Test is:

$$\text{var}(r) = \frac{n(n-2)}{4(n-1)} = \frac{(n-1)}{4}$$

Using the normal approximation: $\frac{\text{Pr}(r < U_R)}{\sigma_R}$
can be determined [Ref. 34].

For example, take two samples one sample of 30 where the equipment service lives crosses the median line a total of 6 times and a second sample where the observations crossed the median line 15 times, the following prob-values would be seen:

$$E(r) = \frac{30 + 1}{2} = 16$$

$$\text{Var}(r) = \frac{30 - 1}{4} = 7.25$$

$$\frac{\text{Pr}(6-16)}{7.25}$$

$$\text{Pr}(3.7)$$

Prob-Value = .0005 which indicates that the sample is not random. On the other hand, in Sample Two with 15 runs:

$$\frac{\text{Pr}(15-16)}{7.25}$$

$$\text{Pr}(.37)$$

Prob-Value = .36 which strongly supports the assertion that the sample was selected at random. Table 12 is a tabulation of the results of the Runs Test for Randomness. The results of the Runs Test support the claim that the samples were drawn at random.

TABLE 12
RUNS TEST FOR RANDOMNESS
NAVAL REGIONAL MEDICAL CENTER

<u>Sample</u>	<u>Bethesda</u>	<u>Lejuene</u>	<u>Charleston</u>	<u>San Diego</u>	<u>Pendleton</u>	<u>Long Beach</u>	<u>Oakland</u>
1	.23	.36	.07	.13	.23	.36	.23
2	.14	.23	.23	.07	.03	.07	.03
3	.23	.36	.07	.36	.13	.24	.13
4	.23	.36	.36	.05	.23	.13	.23
5	.14	.36	.36	.36	.23	.07	.23

D. ONE-FACTOR ANALYSIS OF VARIANCE

A One-Factor Analysis of Variance was used to determine if the samples for the individual NRMC's were drawn from the same population. The answers sought were to the question, "Are the sample means different because of differences in the underlying population means? Or may the differences in sample means be reasonably attributed to chance fluctuations?" Using the methodology outlined by Wonnacott [Ref. 34] Table 13 shows the calculations used to answer the foregoing questions.

E. KRUSKAL-WALLIS ONE-WAY ANALYSIS OF VARIANCE

The next step was to determine if the samples came from identical populations with respect to the sample averages. Accordingly, the Kruskall-Wallis One-Way Analysis of Variance was selected as a useful device for testing the null hypothesis that the samples came from identical populations [Ref. 33].

Table 13
Variance Analysis Results

Source of Variation	Variations Sum of Squares (SS)	Degrees of Freedom	Variance Mean Sum of Squares (MSS)	F - Ratio
Between Rows: "explained" by difference in Means	$\eta \sum_{i=1}^R (\bar{X}_i - \bar{X})^2$	R-1	$MSS = \frac{SS_R}{R-1}$ $= \eta S_x^2$	Explained Variance
Within Rows: residual variation resulting from chance fluctuations "unexplained"	$\sum \sum (x_{ij} - \bar{X}_i)^2$	R(n-1)	$MSS_u = \frac{SS_u}{R(n-1)}$ $= S_p^2$	Unexplained Variance
Total	$\sum \sum (x_{ij} - \bar{X})^2$	(nR-1)		

Bethesda	Lejeune	Charleston	Sample Means				Oakland
			San Diego	Pendleton	Long Beach		
12.8	11.9	10.7	11.8	11.7	11.2		12.6
11.7	12.9	9.2	10.1	11.8	10.0		11.0
12.0	13.0	10.4	12.4	12.9	10.4		11.2
12.4	11.4	9.0	11.3	13.3	10.3		12.4
13.5	13.6	9.5	11.8	11.2	10.5		11.6
12.5	12.6	9.8	11.5	12.2	10.5		11.8 x_i
F-Ratio							
1.26	1.3	1.9	1.9	1.28	.43		1.35
Prob-Value							
.25	.25	.05 < PV < .1	.05 < PV < .10	.25	.25		.25

$H_0: U_1 = U_2 = U_3 = U_4 = U_5$ Level of Significance is 5%

Decision: Reject H_0 if and only if prob-value less than 5% or if F-Ratio greater than 2.37

The F-Ratios in all cases were less than 2.37 and the prob-values were all greater than 5%. H_0 therefore cannot be rejected. The difference in sample means can be reasonably explained by chance fluctuations (Ref. 34).

Table 14
Listing of Sample
Means, Standard Deviations and Confidence Intervals

NRMC, Bethesda, Md

Mean	12.8	11.7	12.0	12.4	13.5
Standard Deviation:	3.6	2.4	3.4	4.8	3.8
Confidence Interval:	(11.5,14.1)	(10.8,12.6)	(10.7,13.3)	(11.0,13.8)	(11.1,14.9)
Average CI:	(11.7, 13.3)				

NRMC, Camp Lejeune, NC

Mean	11.9	12.9	13.0	11.4	13.6
Standard Deviation:	1.2	1.8	1.6	1.6	1.6
Confidence Interval:	(10.6,13.1)	(11.1,14.6)	(11.4,14.6)	(9.8,13.0)	(12.0,15.2)
Average CI:	(11.5, 13.5)				

NRMC, Charleston, SC

Mean	10.7	9.2	10.4	9.0	9.5
Standard Deviation:	4.4	2.4	2.8	2.4	2.3
Confidence Interval:	(9.1,12.3)	(8.3,10.1)	(9.4,11.4)	(9.8,13.0)	(12.0,15.2)
Average CI:	(9.0, 10.6)				

NRMC, San Diego, CA

Mean	11.8	10.1	12.4	11.3	11.8
Standard Deviation:	1.4	0.9	1.4	1.2	1.3
Confidence Interval:	(10.4,13.2)	(9.8,10.4)	(11.9,12.9)	(10.9,11.7)	(11.3,12.3)
Average CI:	(10.6, 12.4)				

NRMC, Camp Pendleton, CA

Mean	11.7	11.8	12.9	13.3	11.2
Standard Deviation:	4.1	3.6	4.7	4.9	2.8
Confidence Interval:	(10.2,13.2)	(10.5,13.1)	(11.2,14.6)	(11.5,15.1)	(10.2,12.2)
Average CI:	(11.2, 13.1)				

NRMC, Long Beach, CA

Mean	11.7	11.8	12.9	13.3	11.2
Standard Deviation:	1.3	1.3	1.1	1.4	1.5
Confidence Interval:	(9.9,12.5)	(8.7,11.5)	(9.3,11.5)	(8.9,11.7)	(9.0,12.0)
Average CI:	(10.0,11.0)				

NRMC, Oakland, CA

Mean	12.6	11.0	11.2	12.4	11.6
Standard Deviation:	3.3	3.0	3.9	3.5	3.0
Confidence Interval:	(11.4,13.8)	(9.9,12.1)	(9.8,12.6)	(11.1,13.7)	(10.5,12.7)
Average CI:	(11.0, 12.6)				

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DEPRECIATION ACCOUNTING IN THE UNIFORM CHART OF
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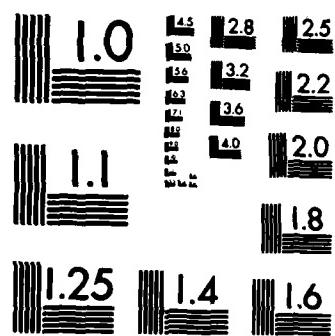
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MICROCOPY RESOLUTION TEST CHART
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In computing the Kruskal-Wallis Test, each sample average was replaced by ranks. The smallest rank was replaced by 1, the next smallest rank by 2, and the largest rank by N. Tied averages were given the mean of the ranks for which tied. The Kruskal-Wallis test determines whether the sums of ranks are so disparate that they are not likely to have come from samples drawn from identical populations [Ref. 33]. According to Siegel [Ref. 33], it can be shown that if the null hypothesis (H_0) is true, and the samples are from identical populations, then the Kruskal-Wallis test statistic is distributed as a Chi Square with degrees of freedom equal to (k-1) where k equals the number of samples. Therefore, if the observed value of the Kruskal-Wallis test statistic is less than the value of Chi Square at the stated level of significance, the H_0 may be accepted at that level of significance.

Table 15 shows the results of the Kruskal-Wallis test. Following Siegel's example, the null hypothesis that the samples were drawn from identical populations can be accepted at the 5% level of significance. The critical value for chi square at 5% significance level with 34 degrees of freedom is 48.6 [Ref. 34]. The Kruskal-Wall's test statistic is 23.34.

F. CONCLUSION

Based on the foregoing analysis of 35 random samples, it is the author's contention that the samples came from identical populations. The analysis further supports the challenge

Table 15

KRUSKAL-WALLIS ONE-WAY ANALYSIS OF VARIANCE

Sample	Camp						Camp							
	Bethesda	Lejeune	Charleston	San Diego	Pendleton	Long Beach	Oakland	Mean	Rank	Mean	Rank	Mean	Rank	
1	12.8	29	11.9	25	10.7	10	11.8	23	11.7	20	11.2	12.5	11.6	18
2	11.7	20	12.9	30.5	9.2	2	10.1	5	11.8	23	10.0	4	10.8	11
3	12.0	26	13.0	32	10.4	7.5	12.4	27.5	12.9	30.5	10.4	7.5	11.7	20
4	12.4	27.5	11.4	16.5	9.0	1	11.3	14.5	13.3	33	10.3	6	11.3	14.5
5	13.5	34	13.6	35	9.5	3	11.8	23	11.2	12.5	10.5	9	11.4	16.5
	136.5	139		23.5		93		119		39		80		

Kruskall-Wallis Test Statistic (H)

$$H = \frac{12}{N(N+1)} \sum_{j=1}^k \frac{R_j^2}{n_j} - 3(N+1)$$

H_0 : Sample averages are from identical populations.

Accept H_0 if and only if the value of H is equal to or less than the Chi Square Critical Value at 5% level of significance.

where:
 k = number of samples
 n_j = number of cases in j th sample
 N = number of cases in all samples combined
 R_j = sum of ranks in j th sample (column)
 $\sum_{j=1}^k$ = sum over the k samples (columns)

that the average useful life of the equipment used at the Naval Regional Medical Centers is higher than the composite eight year service life used in the Uniform Chart of Accounts to determine the annual depreciation expense to charge to patient care.

LIST OF REFERENCES

1. Gibson, Robert M., National Health Expenditure, 1978, Health Care Financing Review, Summer 1979.
2. Rice, Donald B., Defense Resource Management Study and Supporting Papers, Feb. 1979.
3. Department of Defense, Military Health Care Study, Dec. 1975.
4. Department of Defense Instruction 6010.10M, Uniform Chart of Accounts for Fixed Military Medical and Dental Treatment Facilities.
5. Grant, Eugene L. and Norton, Paul T., Depreciation Revised, Ronald Press Company, 1955.
6. Miller, Martin A., GAAP Guide, Harcourt, Brace Jovanovich, 1979.
7. Seawell, L. Vann, Introduction to Hospital Accounting, Revised, Hospital Financial Management Association, 1977.
8. Meigs, Walter B. and others, Intermediate Accounting Solution Manual, 3rd Edition, McGraw-Hill Book Company, 1974.
9. Meigs, Walter B. and others, Intermediate Accounting, 3rd Edition, McGraw-Hill Book Company, 1974.
10. Berretta, Philip L., Regional Controller, Kaiser Foundation Health Plan Inc., Oakland, California. Interview July 1980.
11. Kaiser Foundation Health Plan Inc., Standard Procedures for Property Accounting, 1976.
12. Hasselbald, Gary, Director of Finance, Community Hospital of the Monterey Peninsula, Monterey, California. Interview May 1980.
13. Skull, Gary, Controller, Grace Hospital Inc., Morganton, North Carolina, Interview July 1981.
14. Bishop, Wil, Financial Director, California Hospital Association, Sacramento, California. Interview August 1980.

15. Navy Department, Bureau of Medicine and Surgery, Equipment File List, Naval Regional Medical Center, Charleston, S. C., January 1980.
16. Naval Regional Medical Center, Camp Lejeune, N. C., Item Category Report February, 1979.
17. Daniels, Jeri, Fiscal Officer, Naval Regional Medical Center, Long Beach, California. Interview August 1981.
18. Naval Regional Medical Center, Long Beach, California, Master Property List, June 1980.
19. Naval Regional Medical Center, Bremerton, Washington, Item Category Report, January 1980.
20. Fiscal Officer, Naval Regional Medical Center, Bremerton, Washington. Interview July 1981.
21. Seawell, L. Vann, Hospital Financial Accounting: Theory and Practice, Hospital Financial Management Association, 1975.
22. Department of the Navy, Bureau of Medicine and Surgery, Investment Equipment Instruction 4235.5G, 1979.
23. Department of the Navy, Bureau of Medicine and Surgery Message R052240Z Mar 80, Unclassified N07043 Threshold Change to Investment Equipment Costs.
24. Ferrara, William L., Responsibility Accounting - A Basic Control Concept: Readings in Cost Accounting, Budgeting and Control, South-Western Publishing Co., Cincinnati, 4th Ed., 1973.
25. Cost Accounting Standards Board, Rules and Regulations: Standard 409 - Depreciation of Tangible Capital Assets, 40FR4264, 1975.
26. Department of the Navy, Office of the Comptroller Financial Management of Resources, Publication Number NAVSO P3006-1, 1980.
27. Comptroller General of the United States, Accounting Principles and Standards for Federal Agencies, Title 2, 1978.
28. California Health Facilities Commission, Hospital Accounting and Reporting Manual, Jul 1978.

29. Department of the Navy, Bureau of Medicine and Surgery, Uniform Chart of Accounts Analysis of Inpatient Care, Report Number 20381-M02 Jul 1980.
30. Department of the Navy, Bureau of Medicine and Surgery, Uniform Chart of Accounts Analysis of Ambulatory Care, Report Number 20381-M04 Jul 1980.
31. Horngren, Charles T., Cost Accounting; A Managerial Emphasis, Prentice-Hall Inc., 1972.
32. Sawyer, Lawrence B., The Practice of Modern Internal Auditing, Institute of Internal Auditors, 1973.
33. Siegel, Sidney, Nonparamedic Statistics for the Behavioral Sciences, McGraw-Hill Book Company, 1956.
34. Wonnacott, Thomas H. and Wonnacott, Ronald J., Introductory Statistics, 3rd Ed., John Wiley and Sons, 1977.

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